Electrical World

The consolidation of ELECTRICAL WORLD AND ENGINEER and AMERICAN ELECTRICIAN.
Published by McGraw Publishing Company, Inc.

Vol. 65 NEW YORK, SATURDAY, MARCH 13, 1915 No. 11

Associated Manufacturers of Electrical Supplies

WITH a constitution broad enough to embrace every manufacturer of electrical supplies and of materials entering into electrical construction, there was formed this week in New York an association long lacking and, now that it exists, destined to become the dominating manufacturers' organization of the industry. Dedicated to advance and protect the interests of manufacturers, it recognizes its legitimate functions as well as its limitations and its obligations to the industry. It seeks not to antagonize, but to harmonize; not to destroy, but to create. Enthusiasm and refreshing frankness characterized its formation, and we have been assured that all its affairs will be conducted with the same spirit of sincerity and candor. Time alone can tell how great a constructive force the new association will become; but its keeping has been intrusted to able hands, and it represents a welcome addition to the other national electrical bodies.

N. E. L. A. Committee Work

PREPARATIONS of National Electric Light Association committees for the San Francisco convention in June are at their height. Already some committees have considered the final drafts of their reports and rapid progress is being made toward the completion of others. The constant natural widening of the association's activities means inevitably that the number of committees will be increased. The careful consideration of reports before, during and after conventions is vital to association efficiency and progress. Nothing so discourages committee members as failure to appreciate their efforts and to act on their recommendations. In order that their reports may be readily understandable by busy men, it is the duty of the committee members to practise condensation, terseness and all possible time-saving methods, for by such means only can their recommendations obtain maximum consideration.

Failure to Conserve Is Waste

FUTURE historians of conservation will probably ascribe the failure of Congress to enact constructive water-power legislation at its last session mainly to interference by the emergency ship-purchase bill. In the interview with Mr. Hugh L. Cooper, in this issue, he mentions an indirect cause—the unfortunate lack of public understanding of the important questions involved. Because the public was uninformed it was not interested and did not demand action to discontinue the improvident treatment of lavish natural resources. Since the concentration of Congressional and administrative effort on the ship-purchase bill went for naught, when good conservation bills would have yielded tremendous results, the electrical industry feels keen disappointment. If it is necessary to arouse the public in order to get Congressional action, it is time for the industry to begin anew the presentation of striking facts which tell the need of "conservation with use."

Monopoly Upheld

REGULATION and monopoly in local utilities are akin. Reasonable rates, good service, and limited but fair profits, with freedom from competition, are the essentials. Departure from these principles endangers the whole policy. Occasionally an ill-advised city, lacking in experience, threatens or introduces competition to carry its end. State commissions, knowing that the usual outcome of competition is a consolidation which inflicts all costs upon the public, uphold the doctrine of monopoly during good service. The latest case touching this commission attitude is in strict accord with the best precedent. The Supreme Court of California sustains the Railroad Commission in refusing to permit the Oro Electric Corporation to compete in Stockton with the Western States Gas & Electric Company. If the city had been allowed to overrule the State, regulation in this case would have failed.

Evaluating the Isolated Plant

IN comparing the cost of central-station service with that given by a private plant, most owners with open minds no longer need to be urged to take fixed charges into account as well as operating expenses. However, central-station motor-service solicitors often fail to press home the point that in order to make a really accurate estimate the profit on the plant investment should be added to the interest allowance. Thus, in the case of a textile mill considering a change from steam-engine drive to operation by individual and grouped motors supplied from local central-station circuits it is fair to point out to the owner that all money invested in equipment auxiliary to his business of producing fabrics represents capital on which an annual sum should be figured as lost, representing the percentage of profit that would otherwise have been realized from the same investment in looms, spinning machinery, productive space in the mill, and raw materials. If the mill owner intends to make a yearly profit of 15 or 20

per cent on money put into strictly productive machinery and supplies, he should also figure this percentage on the cost of a private plant as well as the selected interest rate. Enterprises of this class are not, as a rule, undertaken upon the theory that merely the legal rate of interest will be the reward of capital. Instead, a round profit commensurate with the risks of competition is sought, and the power plant should be no more exempt from analysis of this kind than the stock of raw cotton, silk or wool. It is only fair, of course, to estimate a profit allowance on the excess cost of substituting motors for mechanical drive, where such a change is contemplated, but the cost of motors is in most cases of far less importance than the value of flexible service and the economic possibilities in the way of acceleration of output, improvement of production quality, and increased safety of operation. There is reason to believe that some of the difficult cases confronting the central-station motor-service solicitor will yield to the foregoing method of cost analysis, which has been approved by eminent engineering judgment in the field of mill power.

A University Power Station

The requirements with respect to motor service, lighting and heating for educational institutions are somewhat exceptional. In the first place, the numerous buildings scattered over a wide area present in themselves very diverse requirements. Experience has proved the economy of a central heating plant under such conditions, and with this is combined the generating plant necessary for the whole electrical service of the institution, including lighting for all the laboratories, lecture rooms and dormitories, ventilating fans and motors for miscellaneous service, and the energy needed for experimental purposes in various forms and at various voltages. Steam at both high pressure and low pressure must be transmitted considerable distances to reach various points at which it is utilized.

The controlling factor in the choice of a site for the plant described in this issue was the necessity of furnishing high-pressure steam at the campus for various purposes. This proved to be a very serious matter, and when the investment and the efficiency were considered it was found wise to build in a place which was intrinsically not the most desirable. A spur track was built to the railway to take care of the coal supply and, incidentally, the miscellaneous freight coming to the campus. A 30-ton electric locomotive conveys the coal cars from the railway siding over the spur to the station. This work will be done at off-peak times, thus relieving the station of an otherwise somewhat troublesome burden. Use is made of a coal-storage yard of about 6000 tons capacity adjacent to the station. This is surrounded by a concrete retaining wall, which tends somewhat to relieve what would otherwise be an unsightly object.

One of the most interesting features of the station is the provision made for discharging the smoke at a considerable distance. Since the station site is not far from the observatory, it is very likely to be a most undesirable neighbor. However, a scheme which has been evolved for circumventing the smoke difficulty when it becomes necessary to do so will probably be put into service.

The generating equipment is typical of the combination station. It consists of one 625-kva directly connected three-phase unit, driven by a compound non-condensing engine, this type being chosen to fit the requirements of the low-pressure heating mains into which the engines exhaust. Direct current for many existing motors and for the railway is furnished by a pair of 150-kw motor-generators, while the main body of the energy for general purposes is transmitted by cables in a 1600-ft. tunnel, together with the heating mains, to a substation on the campus whence it is distributed to the various buildings. The boiler plant which furnishes steam for the engines and miscellaneous purposes consists of four pairs of 400-hp water-tube boilers working at 140-lb. pressure and equipped with mechanical stokers. The main difficulty with the present site of the plant resides in the fact that the water must be taken from the city mains, a far less serious matter than in a condensing plant. Since the heating necessitates a large supply of water, plans are under way for the installation of a mechanical pumping station at the river to provide an adequate supply of water for the generating station and for the service of the university buildings.

Electrical Supply in London

Attention has frequently been called in these columns to the efforts to devise a practicable scheme for unified electrical supply in Greater London. The latest effort, elaborated by Messrs. Merz and McLellan, has been nullified by the London County Council before it had a chance to reach the parliamentary stage. There seems to be grave doubt as to whether the scheme was a good one from the financial standpoint, while violent opposition developed in the individual boroughs which have been running their own plants. Of the great group of plants in and about London, some are operated at remarkably low expense, so low indeed as to leave a meager margin for profit in case of the supply of energy from a consolidated system. Other local plants, however, are less fortunate.

In addition to the local opposition, for reasons good or bad, there developed against this or any similar scheme of complete electrical revolution the grave difficulty of dealing with the investments already made in financing the existing systems. The total annual charge of the London undertakings for the last year for which statistics are available was about $12,500,000, of which more than half was due to the capital charge and approximately only a quarter to the cost of generating energy. The saving due to the substitution of one or two central plants for those now in operation appears chiefly as a percentage of the generating cost, and the estimates of the engineers predicted a saving of only

18 per cent in the generating cost by the change; in other words, less than 5 per cent of the total annual cost. London already obtains its electricity supply at a cost lower than most large cities, and it became fairly obvious that the effect of centralized generation could not in itself, without an increase of business greatly improving the load-factor, work any revolution in the cost to the consumer. Moreover, under the plan proposed a very large amount of capital would have to be invested in the new station or stations, while there was no available way of realizing on the very large sums already spent on the individual generating plants which would be superseded.

It is here that one encounters the greatest difficulty in all such enterprises. The whole story is that if one could start in a great city anew and build up an electric energy supply system on strictly modern lines he could obtain wonderful results in the way of low cost. As the matter stands, old plants must always be taken care of in the financing of the combination, and the net result is often discouraging. It is quite possible that a great station in London worked out quietly by two or three of the large and successful local supply companies could be made to show a very handsome profit as business increased, the plant expanding at the proper rate to take up the load, as has been the case in some of our American cities. However, irrecoverable investments in many fairly good plants stand in the way of any enterprise worked out as was the one before us, so that it is small wonder that the unified supply scheme has not met with general approval, interesting as it is from an engineering standpoint.

The Kenotron Rectifier

At the midwinter convention of the American Institute of Electrical Engineers announcement was made of a new type of rectifier for converting alternating current into direct current especially adapted to high-tension transmission. The new apparatus, which is called the "kenotron," or "empty device," by its designer, Dr. Saul Dushman, was described in the *General Electric Review*, as noted in the Digest in the current issue.

The mercury-vapor rectifier, already in fairly extensive use, is a vacuum tube containing mercury vapor and depending for its operation on the fact that a much greater voltage must be applied to the device in order to send a current through the tube in one direction than in the other. In the new rectifier there is a very high-vacuum tube with the anode and cathode fairly close together. No current will flow through the tube in either direction even when a very high voltage is applied to the electrodes. One of the electrodes is, however, heated electrically to an incandescent temperature by an auxiliary local source of current, and when this electrode becomes the cathode a current of, say, 1 amp will instantly flow across the vacuum gap, whereas no current will flow if the hot electrode is made the anode. By this means an alternating emf applied to the electrodes is enabled to send a unidirectional current through the rectifier.

An advantage of the kenotron over the mercury-vapor rectifier is that it can be operated apparently at very high voltages, and a group of rectifiers can be run in parallel. It might be advantageous to operate such a direct-current system for transmission "in bulk" from a generating to a receiving station, especially in the case of subterranean connecting cables, which are much easier to construct for unidirectional than for alternating high voltages. It is curious that the "Edison effect," so called because it was first pointed out by Edison as occurring in an ordinary incandescent lamp, should be capable of application to rectification on a very respectable scale. Even if the use of the kenotron should not be developed for energy transmission, the device should prove very useful as a laboratory source of high unidirectional emf.

Combined Oscillator and Radiotelegraph Detector

Following so closely the descriptive article, "The Ultraudion Detector for Undamped Waves," by Dr. Lee de Forest, which was published in our issue for Feb. 20, the paper in the current issue by Dr. A. H. Taylor will be of great interest. Dr. Taylor not only gives data as to results actually obtained in his experiments, but goes into detail as to the arrangement and adjustment of the apparatus used by him. It appears that the disposition of instruments described in the present paper corresponds to the second step in the historical progress mentioned by Dr. de Forest. The audion detector, by virtue of its ability to set up sustained alternating currents of radio frequencies, has been found within the past year or so to be usable as an astonishingly sensitive self-contained "heterodyne" or beats-method receiver for sustained waves. It appears that the combination of incoming and locally generated currents to form electrical beats, and their subsequent rectification to produce audible signals, may be effected by an almost unlimited series of variations in circuit arrangements. The arrangement described by Dr. Taylor is merely one of a considerable number of similar combinations which are capable of producing the same effects to a greater or less degree.

Solutions of the problems of radiotelegraphy seem to be forthcoming with unexpected rapidity, and largely through the work of American scientists. Sustained-wave working was first advanced and used by Fessenden in the United States, as was beat-tone or "heterodyne" reception. American engineers have developed both the radio-frequency alternator and the Poulsen hydrogen arc generator to commercially useful efficiencies, and have improved the technique of beats reception by the production of such oscillators as that typified in the audion. While continuous waves and beats receivers may perhaps not be used in ultimately perfected radio signaling, they form the basis of the best that can now be seen in that art. It is gratifying that workers of the United States have led these developments to their present successes.

LETTERS TO THE EDITOR

The N. E. L. A. Accounting Section

To the Editor of the ELECTRICAL WORLD:

SIR:—Through the approval by the parent body of the organization of an Accounting Section in the National Electric Light Association, I think it is the belief of the present accounting committee, which has formulated the necessary plans for bringing this matter formally before the executive committee of the national organization, that a long step in the right direction has been taken.

Special accounting sessions have been held at the annual conventions during the last few years, when enthusiasm and interest were much in evidence; but with the organization of an Accounting Section an accomplished fact, greater things in this connection may be expected. With all the member companies represented in the national organization working together through the means of the several committees of the Accounting Section, much should be accomplished which will result to the general good of the industry. The Accounting Section has before it a future filled with possibilities, the importance of which it is impossible to estimate at the present time.

With the changes that will be made necessary as time goes on to meet the conditions of complex business, fundamental principles, whenever possible, will need to be evolved as a guide for those who are responsible for developing the business, as strict accounting therefor is of prime importance. "Uniformity" should be the guiding word.

A good start has already been made in this direction by the preparation and adoption of a uniform system of accounts. It is a comprehensive system, and future committees of the Accounting Section should urge its adoption generally, to the end that accounting statistics may be exchanged between companies for comparison and study and for other obvious reasons.

The uniform system of accounts should, from time to time, be brought up to date by incorporating therein any changes in detail that may be necessary to meet changing business conditions, including such new fundamental accounting principles, before mentioned, as shall be recommended by the accounting committee and accepted by the association.

The "question box" is a means of gaining information bearing upon almost any detail of the industry desired by a member company, and will be made the means, through its committee, of advising such companies of all decisions affecting accounting principles arrived at by the accounting committee.

Cost accounting as it pertains to the production and distribution of each kind of service by a public utility is a matter much in the minds of many at the present time. This phase of accounting is rather a new field, which must be developed by the introduction of ideas that may or may not be valid. They must be tried out in actual operation, and the trying out process is one of the most important in the stages of development of anything of this sort. The committee to which this question is assigned will have to feel its way and fix and concentrate its efforts on devising methods and standards adaptable even to the trying-out process.

Eventually, after painstaking study, something may be evolved in the form of definite principles which shall possess the flexibility and uniformity necessary to make them adaptable to conditions existing in any particular locality, thus resulting to the general good of the industry as a whole.

The Accounting Section should be the means of bringing together and harmonizing the views and ideas of the various accountants connected with the member companies of the organization. While the fundamental principles of accounting are standard and uniform, it is the infinite number of details relating to accounting for this particular industry on which there are varying views; and this is not to be wondered at, considering the vast strides made, under varying conditions, in the industry during the last few years.

With a greater field for operation, such as prevails with the organization of the Accounting Section, the possibilities for a comprehensive unification of ideas with respect to essential details may be more quickly brought about.

L. M. WALLACE,
Auditor Edison Electric Illuminating Company of Boston.

Boston, Mass.

Pipe Thawing

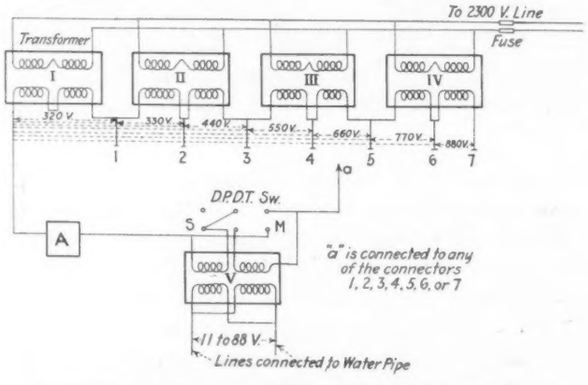
To the Editor of the ELECTRICAL WORLD:

SIR:—In an article in your issue dated Feb. 6 the writer of an article on "Thawing Pipes" advocated the use of a transformer with its primary coils connected to a 220-volt feeder, thereby obtaining a potential of either 11 volts or 22 volts, for the purpose of thawing. Although this system will undoubtedly work in a very limited number of cases, there are two very serious objections to it.

First—The transformers on the line are not always large enough to supply the additional current for thawing. It will often take as much as 25 kw to thaw out a pipe of considerable size.

Second—Either 11 volts or 22 volts is not enough for many cases. Sometimes a potential as high as 88 volts may be used to advantage. The system should therefore be sufficiently flexible to provide a wide range of voltage.

The system shown in the accompanying diagram worked out satisfactorily during the past winter. It gave better satisfaction than the regular thawing transformer, owing to the fact that a wider range of voltage



USE OF STANDARD TRANSFORMERS FOR THAWING

could be obtained from it. Its efficiency is very high because no power is lost in a resistor or choke coil.

Assuming that 500 amp is the maximum current needed for thawing, each of the transformers I, II, III and IV should have a rating of at least 5 kva. All of their primary coils are connected in parallel to the 2300-volt line; their secondary coils are connected in series, with a tap brought out between the two coils

and fastened to a connector. A good method is to fasten all these connectors in a row on a board. Transformer V is so connected to a double-pole, double-throw switch that its primary coils may be joined either in series or in multiple. The secondary coils of transformer V, which furnish the current for thawing, are joined permanently in multiple.

The lead *a* may be connected to any one of the seven connectors, depending upon the voltage needed. When the switch is thrown to the series (*S*) side a potential of 11, 16.5, 22, 27.5, 33, 38.5 or 44 volts may be obtained. When the switch is thrown over to the multiple (*M*) side the potential may be increased from 44 volts to 55, 66, 77 or 88 volts. An ammeter (*A*) may be joined in the circuit. When placed as shown the proper current relations of twenty-to-one for series connection and ten-to-one for multiple connections of the primary coils should be taken into account. Transformer V may be one transformer or several connected in parallel. For a maximum of 500 amp they should have a combined rating of from 20 kva to 25 kva. All of the transformers can be neatly arranged in a wagon to be readily moved from place to place.

A. C. KELM,
Idaho Falls, Idaho. *Municipal Power Plant.*

Photometric Units

To the Editor of the ELECTRICAL WORLD:

SIR:—A complete set of photometric units was defined and adopted by the Illuminating Engineering Society some years ago. That this system of units has found favor with illuminating engineers there can be no question, although it has been the subject of considerable discussion by them since its essentials were presented by Blondel to the Geneva Congress in 1896. Whether or not it has proved acceptable to physicists there is no means of knowing. Mathematical physicists in dealing with problems in radiation have used systems of their own, as a rule far from analogous to that mentioned.

Physicists demand of any system of units that it be simple, rational and teachable; engineers that it be useful. Since the subject has recently been reopened in the ELECTRICAL WORLD,* I venture to suggest a modified system of photometric units which may perhaps prove acceptable to physicists and engineers alike.

The system proposed is fundamentally that used by mathematical physicists in dealing with quantitative problems in radiation, except that radiation in energy units is throughout multiplied by a visibility factor to convert it into light. The effect of this is to make quantity rather than intensity or flux the fundamental unit, since the other photometric units may be derived from it by very simple time and space relations. In the present system the intensity unit (the candle) was formerly considered fundamental, but quite recently the Illuminating Engineering Society committee on nomenclature and standards adopted the unit of flux (the lumen) to serve in that capacity.

Beyond question radiation is properly measured in energy units. This may be thought of as a particular portion traveling off into space or trapped in an ideal, perfectly reflecting inclosure. The rate at which radiation streams through or upon a given area measured in ergs per second (radiation flux) is a distinctly less simple concept. Flux per unit area involves area as well as energy and time. Then follow, in the order of complexity, flux per unit solid angle and finally flux per unit solid angle per unit area, used in the specification of a beam. It is quite immaterial whence the radiation originated or toward what absorbing or reflecting body it is proceeding. It is here proposed to define light quantity, flux, flux density, flux concentration and brightness in precisely analogous terms.

Light *quantity* is, then, radiation in ergs times visibility. It is what has monetary value in lighting and, other things being equal, is proportional to an amount of coal or to a certain amount of kinetic energy in water. The effect of light upon photographic sensitive materials and on the human retina at low intensities is proportional in quantity rather than flux, but these facts have, of course, no bearing upon the rationality of photometric units.

Light *flux* in this system is simply quantity per unit time measured in energy units per unit time (ergs per second, say) times visibility. It is quite analogous to fluid flow in cubic feet per second or to flow of electricity in coulombs per second, and no more rational unit could be devised. Further, the total flux of light from an illuminant is a proper measure of its intensity as in the case of sources and sinks in dynamics. It is obvious that no units of area or of solid angle are involved in defining flux, however convenient they may be in its practical measurement. Quantity is the time integral of flux.

Flux density is flux per unit area. The direction the light is traveling is, of course, immaterial, nor is it of any consequence whether it is entering or leaving a material surface. It may be expressed as the ratio of either differentials or of finite quantities. Total flux is the integral of flux density over an area, independent of distribution or direction.

Flux concentration is a convenient designation for flux per unit solid angle. Mathematically it is on a par with flux density as defined above. Strictly speaking, it is a physical absurdity since a solid angle must have a point apex and no pencil of light can pass through a point. Physical experiment and optical theory agree that the most perfect pencil of light decreases slightly in convergence near an apex. The unit is useful in photometric measurements but is obviously not suitable for a fundamental unit.

Finally both flux density and concentration are involved in the unit of brightness, the remaining unit of importance in photometric measurements. Now, the brightness of a surface to the eye is proportional to the light per unit area leaving the surface and to the light per unit solid angle entering the pupil of the eye. Brightness is, therefore, proportional to both flux density and flux concentration as defined above; that is, to flux per unit area per unit solid angle in the direction of the observer's eye. But, in general, the emitting or reflecting surface is inclined to the direction of observation or is perhaps no surface at all, as in the case of the sky, for example. Hence it appears, on the whole, more rational and fully as convenient to define brightness as flux per unit solid angle per unit projected area.

These five photometric units appear to be those that are both necessary and sufficient to deal with all classes of photometric problems. Their relations to each other are so simple as to require no further discussion. The questions of nomenclature and of standards are, of course, not involved, although these bear the same relation to this as to any other system of units. I have drawn no comparisons with the present system of units to avoid precipitating a controversy at too early a stage. The system here suggested is presented as possibly the simplest and most rational system. Whether or not it is this and at the same time teachable and useful will require extended consideration.

P. G. NUTTING,
Rochester, N. Y. *Research Laboratory, Eastman Kodak Company.*

* "The Unit of Brightness," J. R. Cravath, Dec. 12, 1914; P. G. Nutting, Feb. 6, 1915; H. E. Ives, Feb. 20, 1915.

Central Generating System for University

Electric Coal-Handling Locomotives and Coal-Storage Yards—Utilization of Exhaust Steam—Distributing Energy Through Tunnels

PROBABLY no other educational institution in this country has a central generating and heating plant so elaborately equipped as the one recently constructed by the University of Michigan, of Ann Arbor. Among the features of the system are an electric locomotive for hauling coal and ashes between the station and the railroad, a large coal-storage yard with special coal-handling equipment, a pneumatic ash-conveyor system, the installation of auxiliaries on the main engine-room floor, means of disposing of smoke at a distance from the station, and the transmission and distribution of energy through tunnels.

The station is laid out for an ultimate boiler installation of 4000 hp, but at present it is equipped with only 3200 hp in steaming apparatus and 625 kva in alternating-current generating machinery. The heating mains and electric feeders are conveyed through a 1600-ft. tunnel to a substation on the campus, where energy is distributed through a network of tunnels having an aggregate length of about one mile.

High-pressure steam is required from this system for operating equipment in the central station and in the university laboratories, as well as for sterilizing purposes in the hospitals which are conducted by the university for training its medical students. Low-pressure steam is required for the heating system and for heating water. For a single institution the demand for steam is great. Even in 1912, when experiments were conducted to determine the minimum output of the station, it was found that the hospitals alone required 15,000,000 lb.-Fahr. units per hour, while the campus buildings demanded about 105,000,000 lb.-Fahr. units per hour. Electrical energy is also in considerable demand for illuminating the buildings and grounds, to operate ventilating equipment, and for use in the electrical laboratories.

The old system which has been displaced by the new installation consisted of a power plant on the campus and an underground distributing system laid in brick tunnels. Owing to the rapid growth of the university numerous changes had to be made in the old equipment from time to time, to keep pace with the demands. As only limited space was available in the boiler room, high-rated boilers gradually superseded the old units, and the single brick chimney once employed had to be supplemented by several new smokestacks to give more direct draft to each boiler. In 1913 the cost of transporting coal from the railroad to the generating station amounted to about $5,600, as the coal had to be carted about one mile at the rate of 35 cents per ton. To operate economically under these conditions, it was necessary to use the best grade of Pocahontas coal. At the time the new station was built the old plant contained fourteen boilers having an aggregate rating of 2200 hp and three engine-driven generators having a total rating of 350 kw.

During the last few years' operation of the old plant the facilities were so limited that lamps and motor-driven ventilating fans had to be shut off at definite periods during the winter, otherwise the buildings could not be satisfactorily heated. The delivery of coal to the campus station in horse-drawn vehicles was unsightly and expensive, and to have several steel stacks and one large brick chimney looming up in the midst of many attractive buildings was objectionable from the esthetic point of view. Another condition which made it necessary to rebuild at a different place was the fact that the center of demand was gradually shifting northward, owing to the gradual extension of the campus.

Factors Affecting Location of New Station

Among several locations considered for the new plant, two were chosen for careful study—one about 4200 ft. north of the campus boundary on the Michigan Central

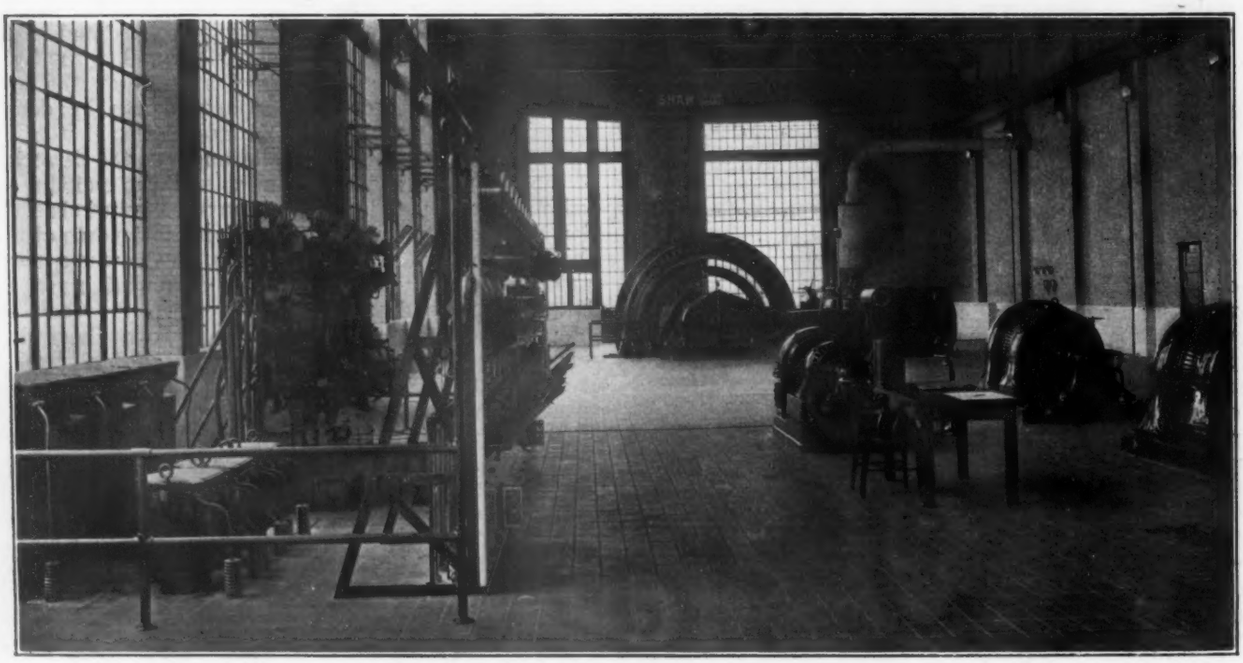


FIG. 1—ENGINE ROOM WITH SWITCHBOARDS AT LEFT

Railroad and close to the Huron River, where coal and water could be obtained without great difficulties; the other about 1200 ft. northeast of the campus at a considerable distance above the railroad and the river but near the center of distribution. In either case tunnels would have had to be constructed in which to convey steam and electricity to the campus and hospital buildings.

If the station had been built near the river, it would have been necessary to transmit the steam to the campus 4200 ft. distant under high pressure, and even if extra heavy pipes had been used the total expansion would have been between 3 ft. and 4 ft. When the investment required for tunnels, piping and electrical equipment was compared with the investment necessary for equipment for hauling coal and ashes and pumping water, moreover, it was decided that the river site was out of the question.

The station was finally constructed on the second site, which is nearer the campus and hospital, or in the "cat-hole" as it is locally termed. In this position the station is more centrally situated for energy distribution, thereby enabling the utilization of all exhaust steam, of standard-weight pipes, and of shorter tunnels radiating to the different parts of the present and future campus. The expense that was incurred in constructing the railroad from the Michigan Central track to the station will eventually be a minor item as the railroad can be used to bring freight to the campus level, which is about 200 ft. above the railroad. The spur can also be used in the future for passenger service, as a branch of the Michigan Central Railroad leading to the center of the campus.

Objections were raised to building the station on its present site for fear that its appearance and its coal-storage yard would depreciate land values in the vicinity, and that the smoke and heated gases issuing from the chimneys might hinder the work conducted in the nearby observatory of the university. These grievances were partly allayed by constructing an artistic station, inclosing the coal-storage yard with a well-designed wall, and providing means for discharging the smoke at a distance from the station in case it becomes objectionable to those using the observatory.

Coal-Hauling Equipment

Coal for the station is received over the Michigan Central Railroad and transported in the original cars to the coal-storage yard by a 30-ton electric locomotive. The track is 4400 ft. long, 59 per cent of it being over 3 per cent and about 16 per cent over 2 per cent grade. The locomotive operates on 500 volts direct-current energy supplied from a third rail through the coal-storage yard and from an overhead trolley through the remaining length of the road. In order that the demand on the generating equipment may not be too great, the locomotive will be operated during off-peak periods, thereby smoothing out the load curve of the system.

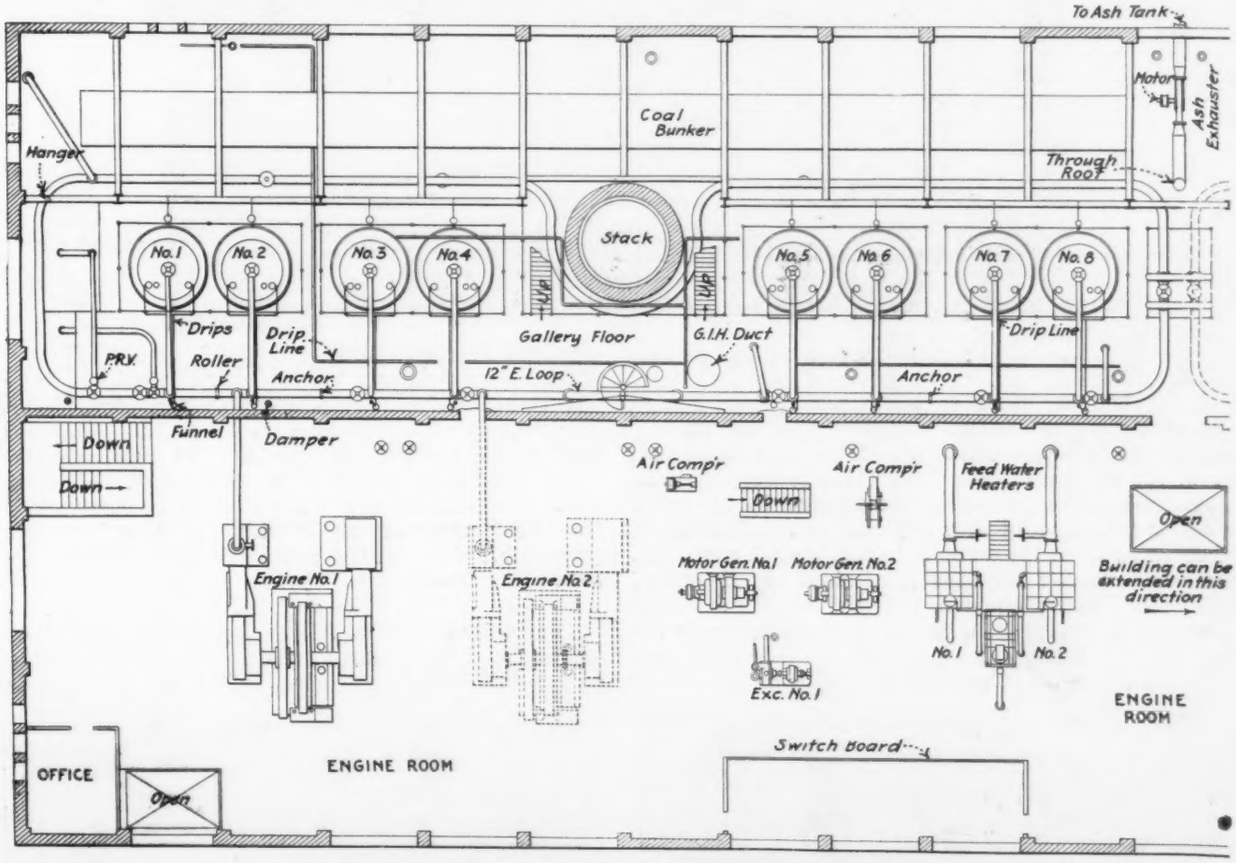


FIG. 2—LAYOUT OF BOILERS AND ENGINE-ROOM EQUIPMENT

Coal-Handling Crane and Crusher

A system of handling coal that requires a minimum amount of manual work, and causes very little dust and dirt, was adopted. The cars as loaded at the mines are brought to the coal-storage yard on an open viaduct, and are either dumped or unloaded by means of a 2.5-

yd. Hayward grab bucket suspended from a 3.5-ton gantry crane operated by four motors. The crane bridge stands 16 ft. above the truck wheels, the runways for which are 45 ft. above the railroad and 72 ft. apart. One rail is supported on the tops of the building

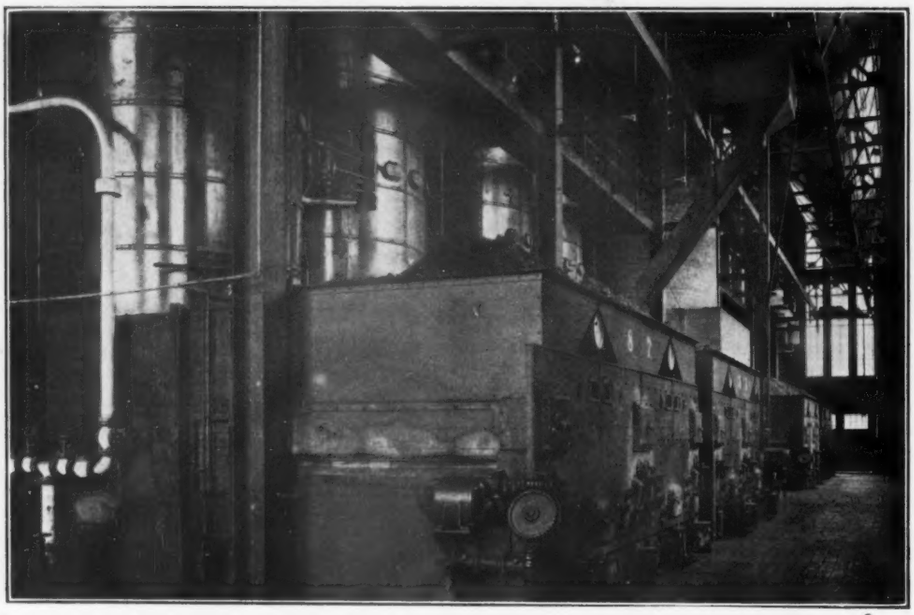


FIG. 3—SECTION OF BOILER ROOM, SHOWING COAL-WEIGHING CHUTE

columns, and the other on steel towers. The bridge, which is composed of two box girders, is 106 ft. long and has a cantilever extension of 17 ft. over each track. From the cantilever over the station is suspended an induction-motor-driven crusher controlled by the crane operator and provided with a by-pass so that it need not be operated when the crane is handling slack coal. The crane and crusher are capable of handling 50 tons of run-of-mine coal per hour. The coal may be delivered either from cars or storage through hatchways in the roof to a 325-ton overhead bunker in the boiler room. With the amount of storage that has been provided very

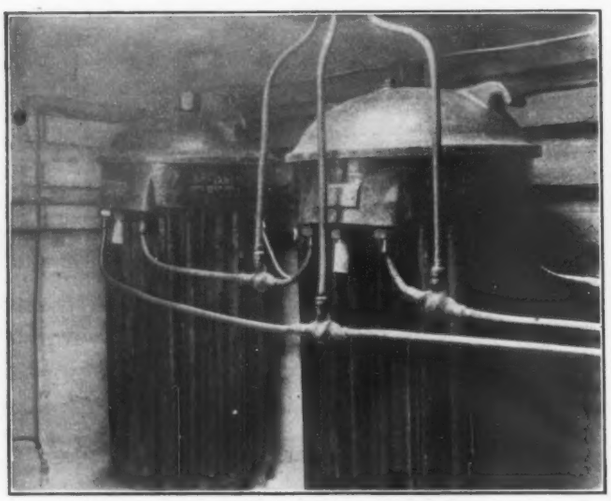


FIG. 4—TYPICAL MANHOLE EQUIPMENT FOR DISTRIBUTING ENERGY

little bridge travel will be required. The crane was furnished and erected by the Shaw Electric Crane Company.

The station, which is 193 ft. long and 107 ft. wide, is so designed and so situated that it can be readily extended in the future. The frame of the building is of steel; the exterior walls are of brick faced with red-tapestry brick with stone trimmings, and the roofs are of reinforced concrete covered with composition and red vitrified tile. The boiler room and engine room lie parallel, the former being nearer the coal-storage yard. The interior of the station is well lighted by numerous steel-sashed windows, the engine room receiving additional light through a large glass monitor. All of the floors are finished with red quarry tile. The walls of the engine room are faced with buff-colored, vitreous pressed brick and have a white-glazed terra-cotta wainscot.

Boiler Room

Four pairs of 400-hp Wickes vertical water-tube boilers equipped with Murphy stokers have been installed so far, but the ultimate plant will accommodate twice

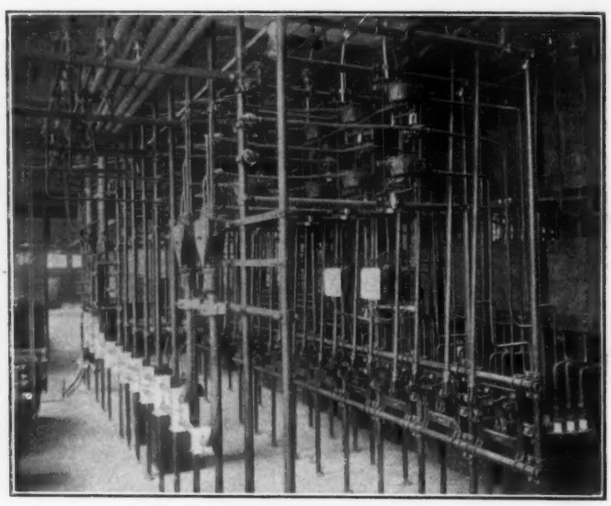


FIG. 5—OIL-SWITCH EQUIPMENT IN BASEMENT OF GENERATING STATION

that number. These units are operated at 140-lb. gage pressure without superheat. The stokers are driven by 220-volt variable-speed direct-current motors, one motor being provided for each battery. The entire setting of each pair of boilers is inclosed with a steel jacket to

reduce air leaks and improve the appearance of the boiler room. Coal is supplied to the stokers from the overhead bunkers through a traveling weighing hopper and distributing chute. The hopper, which has a capacity of 3000 lb., can be filled by opening cut-off gates in the overhead bunkers. The traveling chute, which is motor-driven and floor-controlled, is provided with a ticket-recording device which shows the amount of coal supplied to the boilers. Natural draft is produced by a 175-ft. radial-brick stack, which is 10 ft. in diameter at the top.

The breeching leading from the furnaces to the chimney extends through the basement under the boiler room back of the boiler foundation. It is made of reinforced concrete lined with firebrick. This location is not usual in American generating-station practice, but it makes a very convenient arrangement with the type of boilers used. To afford easy access to all clean-out doors, piping connections and other boiler equipment there has been provided a system of steel galleries, runways and stairs which form a part of the steel frame of the building. The loop system of piping was adopted in this station rather than the unit or panel system as the boiler rating had to be greatly in excess of the generator rating owing to the large heating load. The pipes are so valved that repairs can be made to any part without shutting down more than one unit.

All fittings are of the cast-iron sweep pattern, and long-radius pipe bends have been used instead of elbows wherever possible to reduce the expansion strains and pressure drop. In the steam main leading to each engine is a Victor receiving separator, which is capable of handling eight times the steam required by the high-pressure cylinders with normal cut-off. In the engine-exhaust mains have been installed oil separators and multi-port valves which will open if the back-pressure rises.

Feed-Water Heaters

Two 5000-hp Cochran open feed-water heaters are employed to heat water for boiler feed and domestic

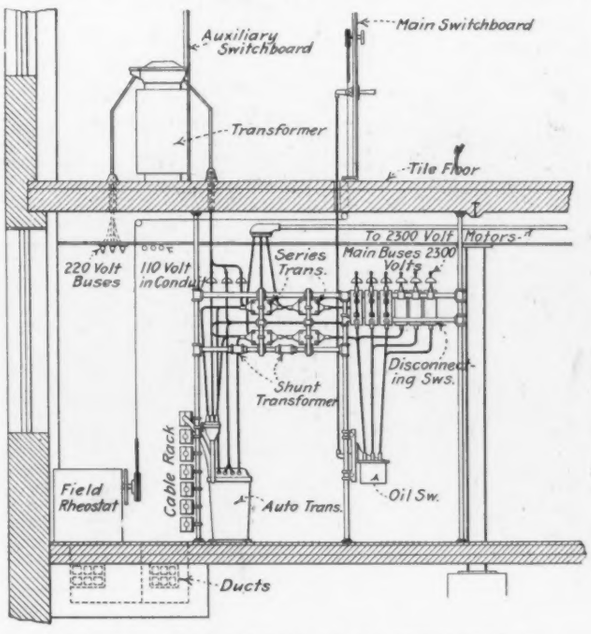


FIG. 6—CROSS-SECTION OF OIL SWITCHROOM

service. The heaters are installed in the engine room about 6 ft. above the floor to provide a gravity flow to the water meters and to maintain sufficient head on the feed-pump suctions to avoid the formation of vapor, which is particularly objectionable when handling hot water with centrifugal pumps. The exhaust steam is led to the heaters through 12-in. exhaust mains and oil separators. A 5-in. float valve regulates the flow of water from the hot wells to the heater. Make-up water is supplied to the float valve through a differential pressure regulator. One side of the regulator control is connected with the float-valve inlet, and the other side communicates with the steam space in the heater; thus a constant ratio will be maintained between the back pressure and the water head on the float valve.

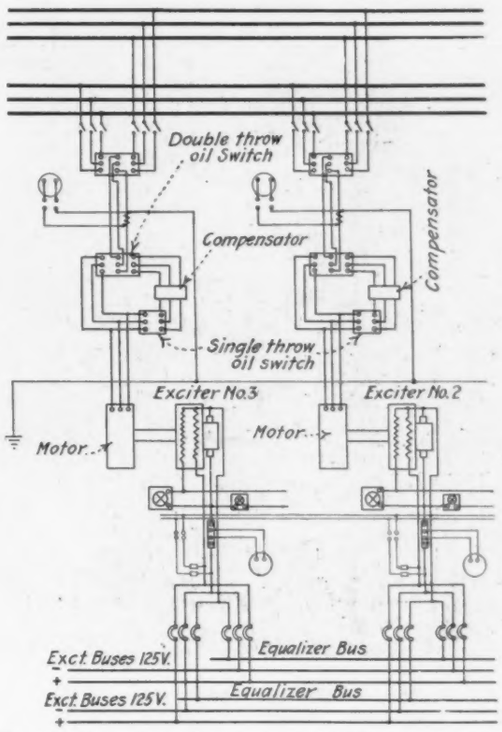


FIG. 7—CONNECTIONS FOR MOTOR-DRIVEN EXCITERS CONTEMPLATED

Hot-Well and Sump Pumps

The hot well, which is below the ash room, receives condensate from the heating system and from all low-pressure lines about the plant. Another reservoir is installed at a lower level to receive all drainage which is too low to flow by gravity into the city sewers. Between the catch basin and the hot well is a chamber in which is installed a 2-in. submerged sump pump and two 4-in. hot-well pumps which can draw water either from the hot well or the catch basin. Each of the pumps is a single-stage centrifugal unit with a vertical shaft directly connected with an induction motor located on the ash-room floor.

Water Meter and Boiler-Feed Pumps

A Venturi meter is employed for measuring feed water, but pipes have been installed for connecting a Lea V-notch recorder which can be used with either heater.

Two pumping units are employed for supplying water for boiler feed and domestic service. Each unit consists of one two-stage centrifugal pump for boiler feed and one single-stage centrifugal pump for domestic service, the two being directly connected to a Terry steam turbine.

Water Supply

At present all water supplied to the generating station is drawn from the city mains, but it is proposed eventually to install an electrically operated pumping station at the river and a water softener which will

furnish an adequate supply of water not only for the generating station but for all university buildings. The softeners which have been considered are of the intermittent type, will operate under constant head and are capable of treating 2000 gal. of water per hour. A complete water-testing outfit is installed in conjunction

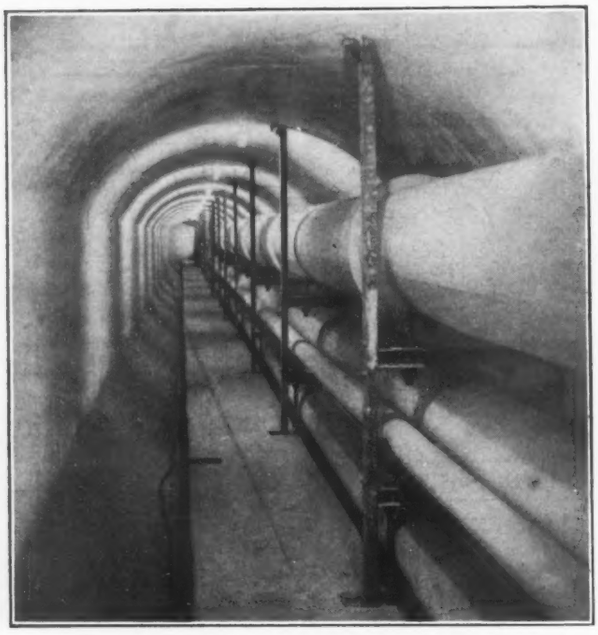


FIG. 8—TUNNEL THROUGH WHICH ELECTRICITY, STEAM AND HOT WATER ARE TRANSMITTED

with the other apparatus described for making periodic tests.

Ash Handling

A pneumatic or suction ash conveyor is employed to obtain the same efficiency and cleanliness as is secured in handling coal. The ash conveyor consists of an 8-in. pipe connected with the hoppers under each stoker and leading to a 50-ton tank supported over the railroad spur in the coal-storage yard. A vacuum of approximately 1.5 lb. is maintained in this tank by means of a General Electric centrifugal exhauster driven by a 220-volt induction motor. The ash hoppers under the grates have been designed large enough to hold all of the ashes collecting in twenty-four hours, so that it is necessary to maintain a vacuum in the tank only a short time. The ashes in the storage tank can be discharged into either a railroad car or a wagon and hauled away.

Engine Room

The engine room was made considerably longer than is required for the engines and generators so that auxiliaries could be installed where they will be readily accessible for making tests and for every-day operation of the plant. A 15-ton traveling crane having a span of 55 ft. clears the floor by 22 ft. The generating equipment consists of one 625-kva, 2300-volt, three-phase, sixty-cycle Allis-Chalmers generator directly connected to a non-condensing 780-hp horizontal cross-compound Corliss engine designed for 120 r.p.m. A non-condensing engine was employed, as 5-lb. to 7-lb. back pressure is desired in the low-pressure heating main into which all of the engines exhaust.

Between the high-pressure and the low-pressure cylinders there are installed horizontal receivers equipped with reheating coils to superheat the steam. The engine is provided with a 20-ton flywheel to permit parallel operation with any generators which may be installed later. By-passing the throttle valves are pipes through which steam can be allowed to pass before starting the engines to heat up the cylinders and prevent initial condensation and hammering.

If it should ever become desirable to install prime movers to utilize the steam to better economy in the station, it will be simple to connect an exhaust turbine between the high-pressure and low-pressure cylinders or at the exhaust of the latter cylinder. Space has also been provided for installing three Corliss engine-driven generators when this becomes desirable.

Exciters and Motor-Generators

One 25-kw, 125-volt exciter directly connected to a non-condensing steam turbine operating at 3600 r.p.m. is provided. When more generators are installed the additional exciters required will probably be driven by 2300-volt motors connected with each other and with the supply circuit as shown in Fig. 7. Such an arrangement will permit using ordinary auto-transformers for starting, after which the motor can be connected directly to the line by reversing the double-throw oil switch in the compensator loop circuit.

As the majority of motors now used on the campus are of the direct-current type and as the electric locomotive also requires direct-current energy, two 150-kw, 220-volt motor-generator sets have been provided. The generators are compound-wound and connected for parallel or series operation. The motors, which are wound for 2300 volts, start as induction machines but run as synchronous motors. They are equipped with directly connected 125-volt exciters so designed as to make it possible to operate the motors as synchronous condensers for power-factor correction. When operating in series the motor-generators furnish energy to a three-wire system from which the electric locomotive or 250-volt campus circuits receive their supply. On light loads only one set is operated.

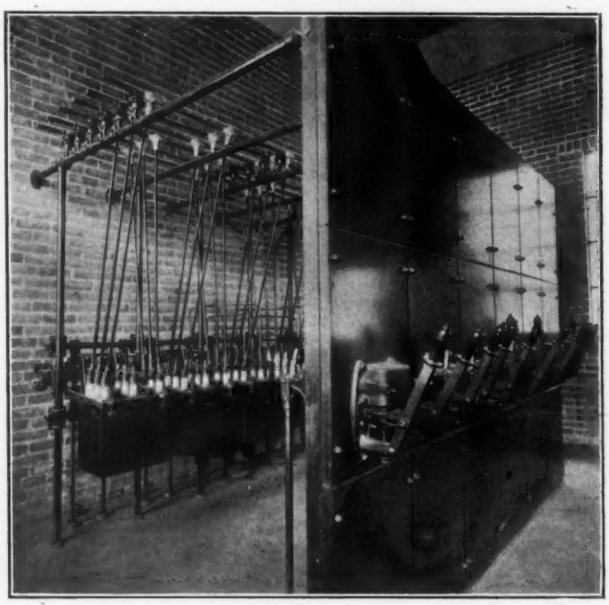


FIG. 9—ELECTRICAL EQUIPMENT IN CAMPUS SUBSTATION

Switchboard

Three switchboards have been installed in this system, the main one being in the engine room to control the main generators, exciters, motor-generator sets and 2300-volt feeders. Back of the main switchboard is an auxiliary switchboard for controlling the station-service circuit. A distributing switchboard is placed in the

campus substation, from which all feeders radiate to the various campus buildings.

The main switchboard consists of twenty-three panels, and practically all of the instruments used in central stations conducted on a revenue-producing basis are employed. No high-voltage wires are installed on the switchboards, all apparatus being controlled through master switches.

The high-tension buses, oil switches and disconnecting switches are installed in the basement below the engine room. Duplicate high-tension and exciter busbars are employed to insure continuous operation and to facilitate making repairs, connections and tests.

Arrangements have been made for synchronizing with the Eastern Michigan Edison Company's system so as to have reserve supply or break-down service.

Electrical Distribution

All 2300-volt conductors between the main generators and the busbars consist of lead-covered cables installed in vitrified conduit, splicing chambers being placed in the engine foundations. All conductors leaving the station are also inclosed in vitrified conduit placed in underground tunnels. At present two No. 00 feeders have been run to the substation, and the hospitals and observatory will be served temporarily by overhead lines. Feeders from the substation are conveyed underground to distributing subway-type transformers installed in manholes. From these low-tension service connections are made with the buildings.

For 220-volt alternating-current service around the central station three 100-kva, single-phase transformers are being used. Energy for station lighting is supplied from three 15-kva, 110-volt, single-phase transformers. The entire load of each set may be carried by two open-delta connected units, but the closed delta connection is employed under normal conditions.

Ultimately it is intended to connect the station with the campus, hospitals, observatory and future buildings by separate tunnels, but at present only the main tunnel leading to the campus is installed. The tunnel is elliptical in cross-section, being 8 ft. wide, 10 ft. high and about 1600 ft. long. Along the bottom of the tunnel have been installed six ducts of vitrified conduit through which the electrical conductors are run. The conduits are inclosed in concrete, and splicing chambers are provided at frequent intervals for pulling cables, etc. Over the conduits is a walkway 3 ft. wide and 2 ft. high. Along the ceiling of the tunnel has been placed a rigid iron conduit with outlets approximately 20 ft. apart for lamps.

In addition to the electrical equipment, there have been installed in the tunnel a 20-in. low-pressure steam main, an 8-in. high-pressure steam main, an 8-in. return line, a 6-in. hot-water line, a 2-in. re-circulating line, and a 2-in. compressed-air line. All of these pipes occupy one side of the tunnel and are supported on special hangers which permit the pipes to move both laterally and longitudinally. Six right-angle turns have been made in the tunnel and the pipes have been anchored between each turn so that expansion of the pipes will not cause them to buckle.

Substation

The tunnel just described terminates in the basement of a brick substation on the campus, where equipment for distributing steam, hot water and electricity is installed. The principal purpose of the substation is to effect a junction between the main feeders from the new generating station and the old campus distributing system. In external appearance the substation is made to conform as nearly as possible with the rest of the buildings on the campus.

The electrical equipment in the substation includes a distributing switchboard made of ebony asbestos board and 2300-volt oil switches which supply energy to 2300/220-110-volt transformers installed in manholes around the campus. All of the energy is distributed underground through a new network of tunnels which connect with the underground transformer stations.

Details of Construction

The large low-pressure steam header enters the basement horizontally and is bent into a rectangular loop standing in a vertical plane to allow for longitudinal expansion. A large gate valve is connected in this loop to control the steam supplied to the campus feeders, which are also equipped with valves. Connection has been made between the high-pressure main and the distributing low-pressure headers through a 6-in. reducing valve, in order that the pressure in the heating mains may always be maintained at approximately 5 lb. to 7 lb. per square inch.

The entire plant was designed by Smith, Hinchman & Grylls, architects and engineers, Detroit, Mich. James Stewart & Company, Chicago, constructed the building and tunnels. The pipe fitting was done by the building and grounds department of the university, which also installed the electrical equipment. Mr. James H. Marks is superintendent of buildings and grounds, and Mr. Thomas Hopwood is chief engineer of the plant.

FIG. 10—COAL-HANDLING EQUIPMENT AND ASH RESERVOIR

The Double-Audion Type of Receiver

Description of the Equipment Used for the Reception of Continuous Radiotelegraphic Waves at Station in North Dakota

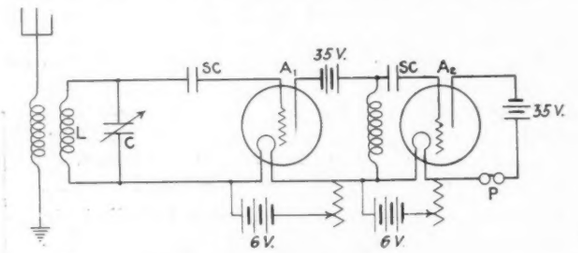
By A. H. Taylor

THE purpose of this paper is to outline briefly a method of using two audions as an amplifying electrical "beats" receiver for the reception of continuous waves in radiotelegraphy. It is, of course, now quite evident that the audion as well as any other type of detector may be used with the heterodyne receiver when the local high frequency is generated, as in the case of the Fessenden receiver, by an auxiliary high-frequency generator or by a Poulsen arc.

Recently there has been put on the market a type of De Forest audion capable of producing continuous oscillations of great purity similar to those of the Poulsen arc, only of much less energy.[1] The writer has had no experience with this so-called "ultraudion," but it seems that this instrument could be used as a local high-frequency generator in connection with any type of detector and receiving set as a heterodyne receiver for continuous waves. It would merely be necessary to couple the oscillation circuit of the "ultraudion" very loosely to the aerial, much in the same manner as a buzzer-test wave-meter coupling. The receiving set would then receive two continuous waves of any desired difference in wave-length, and the pitch of the note produced in the telephone, which I may call the beat pitch, would be equal to the difference in the oscillation frequencies of the received continuous wave train and the "ultraudion" circuit. If in such a set-up the receiver consists of an ordinary audion, we should get a twofold amplification of the strength of the signals. In the first place, as has been pointed out by Mr. John L. Hogan, Jr.,[2] the heterodyne principle itself involves an amplification. If the strength of the received current be denoted by i_1 and the strength of the local high-frequency current be i_2, the energy in the receiver is proportional in the one case to i_2^2 and in the other case to $(i_1 + i_2)^2$. If i_2 is considerably larger than i_1 the increment of energy due to the incoming signal will be $2i_1i_2$. The second source of amplification is due to the fact that, as has been repeatedly pointed out, the audion, while giving a strictly quantitative response, nevertheless is a trigger or relay device, since owing to its operating characteristic it may be worked at a point where the incoming signal releases a store of energy from the local high-potential battery. It is this which gives the audion its superior sensitiveness as a receiver. The receiver used by the writer is not, however, of the external oscillator type. It is somewhat simpler, although it has both of these amplification features and possibly one other amplification.

The receiving set for regular spark stations which the writer has been using for some time consists of two audions connected as shown in Fig. 1. These connections were suggested by an article by De Forest.[3] The connection is, however, slightly different from the one shown by De Forest, inasmuch as the transformer secondary M leading to the second audion is in the De Forest sketches left open, whereas the writer has obtained better results by closing it through a stopping condenser of very small capacity. The transformer used is the secondary of a 0.5-in. spark coil used as an autotransformer. Under normal working conditions this arrangement constitutes an amplifier. Shunted telephone readings have shown that the improvement in signal strength due to the addition of the second audion, while somewhat dependent upon the wave-length, averages from fourfold to fivefold. Whether this is as good as the amplification in the standard amplifier the writer is unable to say, although it is enough to make the double audion or cascade connection decidedly worth while.

The action of this device under normal conditions seems to be as follows: When receiving signals from a spark station the high-frequency oscillations received in the first audion are converted into a series of unidirectional impulses. If the stopping condenser *sc* in the second audion circuit is of large value, these impulses will pass through it bunched together in the form of low-frequency groups corresponding to the spark pitch of the sending station. If, on the other hand, the stopping condenser leading from the transformer to the second audion is of very small capacity, a group frequency of the order of 1000 per second will be shut out. But, on the other hand, the high-frequency pulses will pass through. The second audion in the first case will



CONNECTIONS OF RECEIVER

amplify the low-frequency groups by the addition of local energy from its high-potential battery. In the second case it will amplify the individual high-frequency pulses and deliver them to its telephone circuit smoothed out by the inductance of the telephone in low-frequency groups.

A function of the transformer M is to provide a conducting path for the current from the high-potential battery of audion No. 1 and at the same time to offer a sufficient impedance to avoid the short-circuit of either low-frequency groups or high-frequency pulses. It must be remembered that if the amalgamation of the current from the first audion into low-frequency pulses is to be avoided with certainty, the stopping condenser to the second audion must be of very small capacity and of the order of 5.10^{-4} mf. With the ordinary spark station reception both audions are adjusted to their maximum sensibility. As has been shown, there are two points where the rate of change of the slope of the characteristic current of a normal audion reaches maxima, corresponding to two different values of the voltage in the high-potential circuit. If instead of varying this voltage the heating current of the audion be varied, the correspondence is between two values of the heating current. It is usually more convenient to adjust the audions in this second way.

[1] The manuscript for this article was received from the author on Feb. 8, 1915, and hence no reference is made therein to the article on the "ultraudion" by Dr. Lee de Forest in the Electrical World of Feb. 20, 1915.

[2] *Proceedings* of the Institute of Radio Engineers, 1913, p. 75.

[3] *Proceedings* of the Institute of Radio Engineers, March, 1914.

With this arrangement continuous oscillation signals will, of course, not be received as tones in the telephone unless there is simultaneously impressed upon the circuit a local high frequency in the manner already explained. It is possible, however, to find an adjustment of the audions where local high-frequency current is produced within the receiving audions themselves, thus dispensing with the external generator considered necessary for heterodyne reception. In this connection it is interesting that Eccles[4] has shown the processes in many detectors to be reversible, or, in other words, that if the reception of a continuous oscillation by an ordinary detector—as, for instance, the Galena crystal—results in the formation of a direct steady current through telephones or galvanometer, this process can be reversed by passing a current of the same magnitude in the opposite direction through the crystal from the local battery and providing the crystal with a shunt circuit made up of inductance and capacity. This circuit will then contain feeble oscillations of a frequency determined by its inductance and capacity. That is to say, the detector behaves like a Poulsen arc and generates high-frequency oscillations.

In order for any detector to show this effect R^2 has to be less than $4L \div c$. In general, the audion does not act as an oscillator.

It is well known that the Poulsen arc works best with relatively large inductance and small capacity in shunt. Considering the audion, it is found that the resistance of the circuit is so very high that under ordinary circumstances oscillations do not occur even although the inductance is made as large as is possible while the capacity is reduced. If, however, the audion filament is burned at an abnormally high brilliancy, just on the edge of the blue glow point, the tube resistance is greatly reduced and oscillations may be produced. The presence of the local high-frequency oscillation is made evident by a hissing noise in the telephone. The writer has made experiments with the double audion which show that whenever the hissing noise appears the locally generated high-frequency oscillation is present. The explanation of this characteristic hissing effect is undoubtedly to be found in the presence of this extra high-frequency current, which may be of considerable magnitude.

Referring to Fig. 1, it will be seen, therefore, that the inductance L must be large and the capacity C must be small, although their product must correspond approximately to the wave-length to be received. The effective resistance between the grid and filament of audion No. 1 must be reduced by burning the audion at a somewhat higher brilliancy than that corresponding to the normal adjustment of maximum sensibility. Furthermore, in order for these high-frequency oscillations thus produced in audion No. 1 to pass over into No. 2 by way of the plate of No. 1, the grid of No. 2, the hot filament of No. 2 and back to the hot filament of No. 1, it is necessary that the second audion also have a relatively low resistance. For the two bulbs one should therefore choose those which show the hissing effect. It is well known that all audion bulbs do not show this effect, the reason being undoubtedly that either the vacuum is not right or the distance between filament and grid is too great for them to possess a sufficiently low resistance to allow the development of this high-frequency sustained oscillation.

Two ordinary X-grade audions have been used regularly for some months at this station for "ultraudion" or electrical beat reception of various stations, including the two German stations at Nauen and Eilvese, distant 4300 miles from Grand Forks. In all, five different audion bulbs have been tested in various combinations, and only one, an X-grade bulb with Hudson filament, was found which would not work in this combination under suitable adjustment of voltage and heating current. The adjustment of the second audion is found to be the more important.

In general, the voltage of the high-potential batteries of both audions must be somewhat lower than the voltage necessary to give the best results when used for ordinary reception of spark stations. The same voltage in these circuits may be used for both types of reception, the adjustment from beat-tone reception to simple reception of spark stations being accomplished simply by changing the temperature of the two filaments. The best conditions for each audion must be worked out experimentally. Once determined they are exceedingly constant. Care must always be taken, however, that there are no dead cells of high resistance among the flashlight batteries which make up the source of high potential referred to. This holds especially for the batteries belonging to the first audion, because the local high-frequency oscillation in the capacity-inductance circuit of the receiving set, which is connected on one side to the hot filament and on the other side through a small stopping condenser to the grid, will induce high-frequency pulses in the circuit involving the plate of the first audion, the grid and hot filament of the second, and back through the first high-potential battery to the hot filament of the first. If, by chance, one of the flashlight cells used in this battery has a high resistance, its effect in damping out these pulses will be very serious.

In addition to the high-frequency oscillation determined by the capacity and inductance in the receiving set, there is, as is well known by all operators who have had experience with audions, another oscillation possible whose pitch is quite within the range of audibility. The writer has not investigated this current in detail, but the pitch of the note emitted would seem to depend on the inductance of the telephones and the capacity in the receiving circuit. It is also strikingly influenced by the natural free periods of the telephone membrane. This audible note in the telephones is particularly liable to occur when two audions are connected in cascade as in the present arrangement. A partial explanation of this "siren" effect has been given by De Forest,[5] but the present paper is not concerned further than to note that it must be strictly avoided in beat-tone reception. After several months of practical experience it has become evident that the best results with this "ultraudion" arrangement are generally obtained with an adjustment which is very close to that which inevitably produces the siren.

Aerials Used in Experiments

The aerials at radio station "9 X N," University of North Dakota, used in the tests described in this paper, were of capacity 0.0012 mf and 0.013 mf respectively. The smaller one, consisting of five wires, is 150 ft. long, 12 ft. wide and 85 ft. in height. The other consists of three wires of seven-strand cable in a single span 800 ft. long. It is 20 ft. wide at the far end and 12 ft. at the near end. The free end is 115 ft. in height and points a little east of south. The lead-in is taken from the north end, which is 60 ft. in height. It is estimated that the height to the center of capacity of this aerial is 75 ft.

This aerial will tune to 3000 meters with an inductively coupled transformer whose primary is 5 in. in diameter and has 110 turns of No. 18 annunciator wire. Both primary and secondary are provided with loading coils having "dead-end" switches. One of these loading coil units is variable so that a continuous adjustment

[4] *Electrician*, Oct. 3, 1913.

[5] *Proceedings* of the Institute of Radio Engineers, March, 1914.

may be had of the primary. A fine adjustment of the secondary is made by means of a 0.004-mf rotary variable condenser across its terminals. Signals from South San Francisco, Cal.; Newcastle, Canada; Tuckerton, N. J., and Bolinas, Cal., can be received in the daytime with either aerial with very satisfactory intensity. In fact, the beats receiver brings in the signals of Tuckerton with such strength that they can be heard when the ground connection is removed. They can also be heard and distinctly read if, in addition to this, the aerial is disconnected but is touched with the bare hand of the operator. It is necessary to use the long aerial for the signals from Nauen and Eilvese, Germany, and also for the Hawaiian stations.

The arrangement of Fig. 1 was first tested on signals from the Federal Telegraph Company's station at South San Francisco, "K S S," at a wave-length of approximately 7500 meters.[6] This station has a remarkably constant wave-length and uses a compensating wave differing about 5 per cent from the signal wave. There was no difficulty in separating completely the two waves, as the receiver could be used with a very loose coupling and still receive the signals with great distinctness and purity. The pitch of the "beat" signal note can, of course, be regulated by the setting of the condenser placed in parallel with the secondary of the receiving transformer. If this circuit be exactly in tune with the incoming wave, the beat pitch will be zero. At a wave-length of 7500 meters the frequency of the incoming oscillation is 40,000 per second. One per cent deviation from perfect tuning will, therefore, give a beat pitch of 400 per second; 2 per cent, 800; 5 per cent, 2000. Between 1 per cent and 3 per cent asynchrony the loss in energy due to detuning seems to be negligible; at 5 per cent there is a very decided loss. It seems best, therefore, to keep the beat pitch for stations of long wave-length rather low. The audibility of South San Francisco, while varying slightly from day to day, averages approximately 200 with the "ultraudion" receiver; at the same time a much looser coupling can be used than with the tikker. The distance from South San Francisco to Grand Forks is approximately 1400 miles.

Signals from a Canadian Station

Recently signals have also been received from the Newcastle (Canada) station, signing the call "V A N," which seems to be attempting to establish communication with "P X U." This station is mentioned because it very frequently uses a compensation wave which differs so little from the sending wave that with the tikker it is practically impossible to separate the waves and to read the message. With the heterodyne receiver it is, however, very easy. The two waves give two different beat pitches, and it is easy to read either of these pitches. If it is desired to suppress one of them entirely, the receiving condenser is changed until the beat pitch of the wave to be eliminated falls to zero. The other then has a rather low pitch, but it is nevertheless perfectly easy to read. The wave-length of this station is variable, but has been frequently found at about 8500 meters. The continuous wave received at this station with the greatest intensity is, of course, Tuckerton, N. J., "W G G," sending usually at about 8000 meters. Even the arc equipment of this station, using two waves, is received with greater intensity than any other continuous wave. When the Goldschmidt alternator is used the signals come in on one wave only, but the energy is not entirely broken, the signals consisting of variations in the intensity of the beat note. The signals from Tuckerton are so powerful that they very frequently can be heard 50 ft. distant from the receiving telephones.

Shortly after the action of this receiver had been worked out the writer began to listen for the signals of the German stations at Nauen, "P O Z," 10,000 meters, and Eilvese, "O U I," 7800 meters. These stations are distant 4300 miles from Grand Forks. They are now received practically every day from 2 p. m., Central time, on into the night. The most satisfactory intensity is obtained between 4 p. m. and 6 p. m., as later than that the strays frequently become so violent as to interfere with the reading of the signals. So far neither of these stations has been received earlier than 2 p. m. Central time. Usually Nauen with the longer wave is received with greater intensity.

The audibility of the German stations varies a good deal from day to day and even from hour to hour, espepecially around the sunset period, but at this time of the year it averages about sixteen.

It is to be noted that all three of the machine-alternator equipments give a slight variation or swinging in the beat pitch. This is not of sufficient magnitude to produce any annoyance except when receiving some other station. For instance, if Tuckerton and South San Francisco are both sending at the same time, since the Tuckerton signals are so much more powerful, reception of South San Francisco is greatly facilitated if the beat pitch of Tuckerton is adjusted to zero. There is a sufficient difference in the wave-length of the two stations so that under these conditions South San Francisco can still be read with ease. If, however, the wave of Tuckerton fluctuates slightly, the signals from Tuckerton will now and then creep in as a very low guttural note. With a little attention to the adjustment of the receiving condenser, this can be easily corrected, as the beat pitch of the Goldschmidt station swings very slowly.

This type of receiver for obvious reasons works much better on rather long waves, the most satisfactory results having been obtained between 5000 meters and 10,000 meters. The reason is quite evident if one considers the condition necessary for the production of local oscillation, namely, that R^2 must be less than $4L/C$. On attempting to adjust the receiver for wave-lengths in the neighborhood of 3000 meters from some of the west coast stations of the Federal Telegraph Company considerable difficulty was experienced in producing the necessary local oscillation. For short waves the inductance L was considerably reduced, but, on the other hand, the capacity C could not be satisfactorily reduced to a desired minimum because the stopping condenser itself furnished a limiting value. Moreover, if C be made too small, the slightest movement of the hand in the neighborhood of the receiving apparatus will destroy the adjustment by changing the capacity of the set. This makes the adjustment very difficult for waves below 3000 meters. The adjustment has, however, been carried out down to much shorter wave-lengths. With a little practice the 3000-meter stations mentioned can be received readily enough after 12 m. Central time.

The "ultraudion" receiver is, of course, effective also on damped oscillations, especially if we deal with long and feebly damped waves, as, for instance, those emitted by Bolinas, Cal., "K E T," at about 6500 meters. This station can be received any time in the afternoon, and observations have most frequently been made at about 12:15 p. m. Central time, when Bolinas is apparently opening communication with the Hawaiian Islands. An interesting opportunity is here accorded to compare the operation and sensibility of the ordinary reception of the double audion and the "beats-ultraudion" reception. With the ordinary adjustments the signals of Bolinas are received with an average audibility

[6] The values of wave-lengths given are only approximate as a wave-meter had to be provided with multiplier and extrapolated to these long wave-lengths.

of about forty. The note is a peculiar one inasmuch as it can be heard continuously in between the dots and dashes, the dots and dashes consisting of increments of intensity. The note is quite clear, but is nevertheless typical of a spark station and nothing like the clear, flute-like note obtained when the "ultraudion" is used on continuous waves. When the locally generating adjustment is made for "K E T," the signals become exceedingly hoarse and rough, completely losing their tone quality but gaining tremendously in intensity, their audibility frequently reaching several hundred.

Another Marconi station, not yet identified but probably Glace Bay, N. S., has frequently been observed at about 8500 meters with the "beats" receiver, whereas this station can barely be heard at all with the ordinary adjustment. This is also true of the Hawaiian Station, "K I E."

The oscillating adjustment is easily, with the spark stations, shown to be at least ten times as sensitive as the ordinary double audion adjustment. With spark stations, however, the loss of the musical quality of the note is a serious handicap, and from the nature of the combination of the undamped local oscillation with the damped oscillation having a group frequency as emitted by the spark station, the difficulty seems unavoidable. Similar experiments have been made upon the signals from Arlington at 2500 meters. A tremendous gain in the intensity of the signals has been noted here as elsewhere, but owing to the loss of their musical quality the readability of the signals through atmospheric or "strays" has not, in the opinion of the writer, been very materially increased. It is evident, however, from these experiments that the "ultraudion" reception of continuous waves is exceedingly efficient because the amplification is retained and the musical quality is absolutely perfect. Moreover, the pitch is under immediate control of the receiving operator.

Reception of Very Short Waves

In conclusion, a few comments on the possible "ultraudion" reception of very short waves may be in order. If a continuous oscillation of 300-meter wave-lengths were possible, it would correspond to an oscillation frequency of 1,000,000 per second. A beat pitch of 1000 would correspond to a detuning in the receiving secondary of one-tenth of 1 per cent of absolute synchrony. Asynchrony to the extent of 3 per cent would produce a beat pitch of 30,000, which is practically at the limit of audibility and decidedly above the possibility of the ordinary telephone. If, however, we consider the reception of a damped wave of 300 meters, we can see that with a beat pitch of 30,000 the pitch actually heard in the telephone would be that of the group frequency of the spark station emitting the wave. At the same time the amplification inherent in any type of heterodyne reception, as explained in the first part of this paper, would greatly increase the strength of the received signals. Some experiments have been made recently at this station using the double audion burned at a great brilliancy for the reception of amateur stations "8 P P," "8 T I," "8 F J" and others, all of which are in Ohio, distant 800 miles from this station. The intensity with which the signals of these amateurs have been received, rising often as high as an audibility of 100 to 150 and in some cases even higher, leads the writer to believe that the adjustment used for the audions was really an adjustment in which oscillations were locally generated. In any event, the signals are not received at all when the temperature of the filament of the lower audion is kept at a lower point corresponding to the reception of other spark stations of somewhat longer wave-length. This point will be further investigated.

FACTORS IN RATE-MAKING—I

Considerations Which Govern Rates and Some New Forms of Utility Schedules

BY ARTHUR S. IVES

There is no doubt that the most important problem before the manager of any electric or gas company is the adoption of a satisfactory system of rates. Economical production is, of course, equally important, but, owing to development and standardization of equipment and methods, it is less serious as a problem than rate-making.

Any one attempting to study rates a few years ago would have found considerable pioneer work by Doherty and others, but very little literature on rates or rate-making. Now the technical papers are full of articles on the subject, so that apparently full information is available. However, there are certain fundamental considerations which seem to have been overlooked and detailed methods of analysis which have not been explained fully, so that this paper is submitted with the hope that it may be of assistance, especially to smaller companies.

The first electric rates were necessarily "flat," because there were no meters worthy of the name. Charges had to be based on connected load, number of lights, horsepower of motors, etc. Even when practical commercial meters began to be developed, it was out of the question, owing to their high cost, to use them for small consumers.

In the meantime the glaring disadvantages of the flat rate became apparent, namely, waste or reckless and unnecessary use by the consumer because the cost to him was based only on connected load and not on the energy consumed.

While metered rates, which followed the introduction of accurate meters at reasonable cost, brought relief from former conditions, new difficulties of a different character arose. The consumer stopped wasting energy, but he frequently increased his connected load and hence maximum demand far in excess of the average on which his rate had been based; hence the central station suffered again by being made to install extra generating capacity.

Another difficulty with the "straight metered rates" (as they should properly be called) is that they did not permit of inducements to be offered to really desirable consumers with small demand and long hours' use, without apparent discrimination, which would not be sanctioned by the laws.

We see therefore that neither flat nor metered rates could satisfy the general conditions of equity between central station and consumer, so that finally a combination, the "load-factor rate," was developed, which takes account of connected load (or, more properly, maximum demand), as well as of energy consumed, or, in other words, is based on the "hours' use" of the consumers' demand or installation, as the case may be.

The reaction from metered rates to some system which would also take account of connected load was promoted by the tungsten lamp and consequent reduction in energy per lamp.

Load-Factor Rates

To-day progressive central stations have load-factor rates, some exclusively and others as an alternative for all but small residential consumers.

This class of rates is susceptible of many variations, such as whether the consumer's maximum demand shall be measured or estimated, and in the latter case as to the basis of such estimate; but the principle is the same, namely, to reproduce for the consumer the same conditions of cost that would obtain if he were to install and operate his own generating plant.

For example, a consumer with a maximum demand of 100 kw, if desiring to supply his own requirements, would have to install a plant capable of meeting this demand at all times, while one having a demand of only 50 kw would require a plant only one-half as large. Hence the plant or investment, and therefore fixed charges, must be proportional to maximum demand. Furthermore such operating costs as coal, oil, labor, etc., will be proportional to the number of hours this demand is used or operated.

In other words, whether the owner knows it or not, the isolated plant automatically serves him at a load-factor rate because such a rate represents actual conditions of cost.

Now, what is true of the isolated plant is fundamentally true of the central station. The load-factor rate is therefore the most logical type or class of rates so far devised, as it is more nearly proportional to the cost of service in each particular case than any other system. Central stations which have adopted it have made the greatest headway against isolated-plant competition for reasons which will be apparent readily from the above.

The Theoretically Perfect Rate

By means of a theoretically perfect system of rates each consumer would be charged an amount exactly proportional to the actual total cost of service rendered. Items of cost may be divided into two general classes:

(A) "Fixed charges," which are the direct result of the required investment of fixed capital.

(B) "Operating expenses," which are incident to operation after the investment shall have been made (not included in class A).

If every consumer was an average consumer and was served under like conditions, fixed charges should be divided among consumers in proportion to respective maximum demands, while operating expense would be divided in proportion to consumption.

But this is not the case, and, since the theoretically perfect rate should give a proper charge to each individual, it must take into account every varying condition which would affect cost, such as:

(1) *Conditions Affecting Fixed Charges.*—Consumer's maximum demand; interweave of consumer's demand with demand of other consumers on same circuit or transformer, on same transmission feeder and on same generating station; distance of consumer from generating station; type of construction required to reach consumer; if underground, type of street paving; if overhead, size and spacing of poles; number of consumers and total demand per square mile, or other unit of area, in his neighborhood; total demand supplied by same transmission feeder and by same generating station.

(2) *Conditions Affecting Operating Expense.*—Time and duration of demand; number of hours' use per day or per year; period of day or night when use occurs; length of distribution wires required to serve consumer; class to which consumer belongs, viz.: apartment, residence, store, factory, etc.; length of time consumer occupies one location; distance of center of gravity of distribution from generating station; distance of consumer from nearest office of company; number of consumers per square mile, in his neighborhood; number of consumers supplied by company.

Inspection of these lists of variables will suggest that while the cost of serving a customer depends on his maximum demand and load-factor, the unit cost per kilowatt of maximum demand is not the same for each consumer but depends also on his distance from the generating station, the type of construction used to supply service, the density of other consumers per unit of area, and the interweave of his demand with other demands; while operating cost may vary with time of day, distribution losses due to distance, and relation of the consumer's individual demand and load-factor to the average consumer's demand and load-factor.

It is perfectly possible to devise formulas which will take all of these things into account, but it would be found that many variations would be so small as to be negligible, and the determination of, and allowance for, many of the others would add considerably to the general expense of the company without sufficient counterbalancing gain to consumers. The practical solution is to divide all consumers into classes and devise a proper rate for each class.

Classification of Consumers

Consumers may be classified in various ways. The primary classification should be according to geographical districts.

These may be of three kinds: (a) zonal with respect to the distance of the center of each such district from the generating station or center of distribution; (b) where special forms of construction have been employed, such as underground conduit or cable, and (c) with reference to density of population or of consumers to be supplied from a single distributing circuit. The effect of each variation on cost is obvious.

The second classification should be apparently with regard to purpose for which service is used, such as light, power, heat, etc. This may seem purely arbitrary, and many have claimed that it makes no difference to the company what becomes of a kilowatt after it passes through the meter. Were it not for the difference in the "interweave" of the several services such a contention might be correct.

By "interweave" is meant the relation between the generating capacity required to supply service to a number of consumers and the aggregate sum of their individual maximum demands. The interweave for consumers using energy for motor service is considerably less than for consumers using energy for light, and this is the real and substantial reason why motor-service rates should be lower than light rates. A low interweave means less cost for plant per kilowatt of consumers' demand.

The interweave is then the true basis of the second classification, and consumers should be divided into as many classes as are necessary to allow for variations in interweave. For simplicity of presentation these classes can be named as stated above, in accordance with purpose for which service is used.

The third classification is with reference to the time at which the consumers' maximum demand and service generally is imposed on the generating station. This takes care of such differences in cost as between peak and off-peak loads.

The fourth classification is based on the size of the consumers' load and takes care of the difference between wholesale and retail consumers. There are certain costs in rendering service which are considerably less per unit for large than for small consumers, and the "wholesale" principle has been too well recognized in all business to need special argument.

These four classifications are general, but in special instances local conditions may be met by additional classifications.

Having agreed that the first practical consideration is to treat consumers as composed of classes rather than individuals, we must determine the cost of serving each separate class, with as accurate detail as possible. Costs for each class should be segregated into at least three different divisions:

(a) Investment charges, which include interest, depre-

ciation (or amortization), insurance and taxes resulting from capital investment, which are proportional to consumers' demand.

(b) Energy charges, which include such items of operating expense as are dependent on the energy required.

(c) Consumer charges, which include such items of operating expense as are independent of either amount of investment required or energy sold but are proportional to the number of consumers served.

If there are any other items which cannot be included in such a classification, they should be taken into account in the final rate form.

In making this analysis practically for each given case, as stated, every possible detail should be taken into account, without regard to the complexity of the result or the ultimate rate adopted. The important thing at this stage is the true cost for each condition. Commercial considerations come later.

Classification of Rate Forms

All rates may be grouped under some of the five general classes:

(1) The flat rate, where no meter is used, and the charge is either fixed arbitrarily per period or is based on some unit such as size of building, or on number and capacity of energy-consuming devices, or even on the output of consumer's product.

(2) The quantity-meter rate, where the charge is based on the quantity of energy consumed during bill-period as measured by an integrating meter, generally in kilowatt-hours.

(3) The demand-meter rate, where the charge is based on the demand of the consumer's installation as measured by an indicating meter, generally in kilowatts.

(4) The two-charge or load-factor rate, where the charge is based on both quantity of electric energy consumed and capacity or demand of the installation.

(5) The three-charge or "Doherty" rate, where the charge is based on (a) quantity of energy consumed, (b) capacity or demand of the installation, and (c) number of consumers, meters or service connections, or some similar unit.

These are general classes, and each class is subject first to the following primary modifications: The price or rate per unit may be:

(1) A uniform rate, where the price per unit does not vary on account of any increase or decrease in the number of units under consideration.

(2) A step rate, where the price per unit varies with the number of units according to a given schedule, but is the same for all of said number.

(3) A block rate, where the price per unit is different for each succeeding block of units, and the total charge is equal to the sum of the value of each block of units taken separately.

These modifications, applied to the five general classes, give forty-five different variations to start with, there being nine combinations in the two-charge class and twenty-seven in the three-charge.

Each and all of these rates may be subject to secondary modifications because of discounts and guarantees.

Discounts are of two general classes: Wholesale, or depending on quantity only; prompt-payment, in consideration of time within which bills are paid.

"Wholesale discounts" may also be uniform, step or block, and the affected units may be simple or compound. Or, in case of the two-charge and three-charge rates, discounts may be allowed on one charge and not on the others, or different discounts on each. Guarantees of a minimum number of units to be consumed automatically produce a higher rate per unit for any less number of units.

In addition to these comparatively simple forms there have been devised other special variations of two-charge and three-charge rates which in some cases have produced very satisfactory results, but generally such variations have been at the expense of simplicity.

Of all the rate forms, there is no doubt that the three-charge block rate with proper discounts and guarantees will be most nearly proportional to cost of service, and to that extent will approach most nearly to the theoretically perfect rate. This is because of the greater number of variables entering into the rate and remaining a part of its final form. On the other hand, this form of rate is used less than any other form.

A successful rate must not only be fair and equitable, but it must be in a form which the public can understand and appreciate, which means that it must be simple and with as few variables as possible.

Our object then must be to develop an empiric rate in simple form that will correspond as nearly as possible to the theoretical curve of cost with all of its variables as heretofore described.

While devising a new schedule of rates for an electric company a few years ago, the writer suggested a form which was adopted and has since proved very satisfactory, but which, it is believed, will be new and interesting to many. It was modeled after the form of the well-known limited-service telephone contract in which the customer pays a specified monthly sum, for which he is allowed a certain number of calls. If he uses more, he pays an excess rate.

The electric rate in like manner provides that the consumer shall pay a minimum monthly bill proportional to his maximum demand, in consideration of which he is allowed to use all the energy he wishes up to a certain number of kilowatt-hours per month. If he uses more he pays an excess rate per kilowatt-hour therefor.

The amount of the monthly guarantee divided by the kilowatt-hours allowed per month corresponds to the primary rate, which must take account of fixed charges and consumer charges, as well as the cost of the energy allowed. The excess or secondary rate, therefore, need take account only of the cost of excess energy, all other items of cost having been included in the primary rate. The reduction in the unit value of the consumer charge (per kilowatt-hour) is taken care of by a system of wholesale discounts, a well-known rate device which is easily understood and appreciated by the consumer.

In this particular company the primary rate adopted was 12 cents per kw-hr. and the secondary 5 cents, but with this form of rate the primary rate never appears directly, so that the only rate presented to the customer is the secondary. An example for commercial lighting, using the 12-cent and 5-cent schedule, follows:

A consumer having a maximum demand of 1 kw would pay $6 per month and would be allowed 50 kw-hr., paying 5 cents per kw-hr. for all excess used over 50 kw-hr. during each month. If he used no excess, his bill of $6 would not entitle him to any wholesale discount. With a bill of $10 or more the wholesale discount would appear.

A consumer with a maximum demand of 20 kw would pay a minimum monthly bill of $120 and be allowed 1000 kw-hr. For excess he would be charged 5 cents per kw-hr. as before. On a bill of $120 per month he would be entitled to a wholesale discount of 12 per cent, and this discount would increase with the size of the bill.

For other classes of consumers, such as residence lighting, motor-service, heating, etc., the same form is used but with different factors.

As stated, this form of rate can be made to conform to any theoretical curve by selection of the proper factors for base rates and discounts.

(To be continued)

DIGEST OF ELECTRICAL LITERATURE

Generators, Motors and Transformers

Polyphase Commutator Machines and Their Application.—N. SHUTTLEWORTH.—The first part of a long abstract of a paper read before the (British) Institution of Electrical Engineers. The paper is illustrated by numerous diagrams. The author briefly deals with the main principles of polyphase commutator machines and then considers from a practical and theoretical standpoint the various types, including the Latour motor, the Eichberg three-phase shunt motor and the series commutator motor. He will discuss in the next instalment both series and shunt cascade-connected commutator motors and the Schrage variable-speed shunt commutator motor.—London *Electrician*, Feb. 19, 1915.

Parallel Operation of Alternating-Current Generators Driven by Internal-Combustion Engines.—R. E. DOHERTY AND H. C. LEHN.—A composite article in which the first author discusses the factors affecting the generator design and the second deals with the factors affecting the engine design.—*Gen. Elec. Review*, March, 1915.

Lamps and Lighting

Spiral-Wire Tungsten Lamps.—B. DUSHNITZ.—The conclusion of an illustrated article on spiral-wire tungsten lamps in their particular application to search-lamps and projection apparatus.—*Helios*, Jan. 24, 1915.

Half-Watt Tungsten Lamps as a Substitute for Arc Lamps.—A. BOJE.—The conclusion of his article. Having given detailed figures for the lighting of bridges, the author now takes up the interior lighting of a storage house, a storeroom and a department store. In the last case his figures show that the substitution of half-watt tungsten lamps for arc lamps reduces the operating cost by 28.6 per cent and simultaneously increases the aggregate candle-power by 30 per cent. In general the author concludes that even now it is very advantageous to replace arc lamps with pure carbon electrodes by half-watt tungsten lamps.—*Elek. Zeit.*, Jan. 28, 1915.

Generation, Transmission and Distribution

Generating Plant at Colliery.—Prior to the present installation, the Manners Colliery Company, Ilkeston, England, purchased energy from the local power company, whose generating station is close to the colliery. With the extended application of electric driving, and in view of the fact that a large volume of exhaust steam was available, the management decided to establish a power station to which extensions might be made as circumstances necessitated. The initial plant comprises a mixed-pressure turbine receiving high-pressure steam at 100 lb. and exhaust steam from the two pairs of winders and the fan engine at a pressure of, or slightly below, 17 lb. absolute. The turbine is of the low-speed type, running at 1500 r.p.m. The turbine is connected to a 300-kw turbo-generator giving three-phase currents at 440 volts, twenty-five cycles. The power house also contains a compound engine directly coupled to a 150-kw alternator running at 375 r.p.m. This set, which takes steam at 100 lb. pressure, can be run exhausting to atmosphere through the turbine, or directly to the condenser. The set serves to take the night and week-end load.—London *Iron and Coal Trades Review*, Feb. 5, 1915.

Water-Power Plant.—J. W. LINK.—A paper on the Coon Rapids low-head hydroelectric development on the Mississippi River near Minneapolis, Minn. The capacity is 15,000 hp. The generators produce three-phase current at sixty cycles and 33,000 volts. For transmission to Minneapolis the emf is stepped up to 13,200 volts by two banks of 1375-kva, sixty-cycle, single-phase water-cooled transformers.—*Journal Western Soc. of Eng.*, December, 1914.

Electricity on the Rand.—A table made up from data compiled by the South African Institute of Electrical Engineers on electric generating plants and large winding machines installed on the Rand. Figures are given on eleven electric supply companies and six mines.—*London Elec. Review*, Feb. 12, 1915.

Boiler Efficiency.—R. ROYDS.—A long paper illustrated by numerous diagrams giving theoretical notes and results of experimental tests on heat transmission and efficiency of boilers. It is suggested that one of the most important problems affecting the efficiency of a boiler at high rates of working is the proper combustion of the fuel.—*Transactions Inst. Eng. and Shipbuilders in Scotland*, February, 1915.

Traction

The Effect of Motor Characteristics on Traction Economies.—J. LISKA.—A long translation in abstract of his recent German paper in which the author outlines the effects produced by those methods which weaken the field in the main motors.—London *Electrician*, Feb. 5, 1915.

Switchboard for Automobile Charging.—An illustrated description of a switchboard for electric vehicles so designed as to suit equally well the small user's garage or the large public garage. It is composed of panels, each being complete in itself and containing all the apparatus necessary for dealing with one battery. As many as six panels are comprised in one frame.—London *Electrician*, Feb. 12, 1915.

Installations, Systems and Appliances

Induction Regulators.—G. H. EARDLEY-WILMOT.—An article illustrated by numerous diagrams on the principles of design and operation of polyphase and single-phase induction regulators and the main uses to which they may be put in practice. Fig. 1 shows the kind of

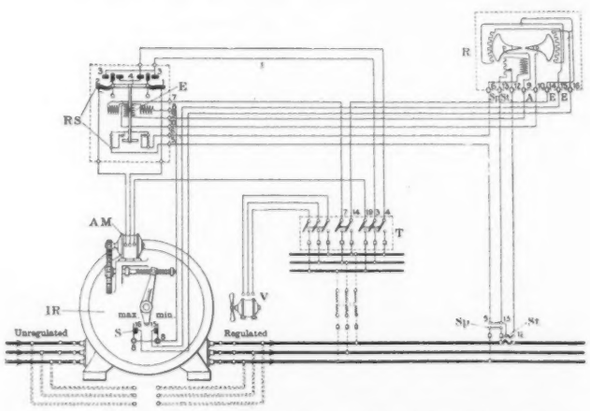


FIG. 1—CONNECTIONS FOR INDUCTION REGULATOR

arrangement of electric control of induction regulators used by Brown, Boveri & Company. The movement of the induction regulator *IR*, by means of which the feeder pressure is being regulated, is effected by means of the auxiliary motor *AM*, which operates through reduction gearing and a suitable link, and thus brings about the necessary displacement of the motor of the regulator. The motor is controlled by a rotary electromagnet *E*. This magnet is provided with a cam for

operating the reversing switch *RS* fitted on one end of its spindle, while on the other end is fitted a device for braking or releasing the motor. The resistors of an automatic induction regulator are connected in series with the field winding of the magnet (across the low-pressure supply) so that the magnet is permanently energized. The armature of the magnet is connected across the rolling sector contacts of the regulator, and so long as these sectors are in their mid-position no current is produced. If the feeder pressure alters, the sectors roll in one or other direction according to whether the pressure rises or falls, and a current is produced at once in the armature of the magnet, and the motor *AM* is turned in a suitable direction, so that the position of the armature of the induction regulator is altered and the pressure brought back to its normal value. Directly this has occurred the sectors of the automatic pressure regulator resume their normal position, and the current is again cut off from the driving motor. If, instead of keeping the line pressure constant, it is required to compensate for the pressure drop in the line, the regulator *R* is compounded by means of an adjustable shunt, so that any degree of compensation can be obtained. The object of the switch *S* is that should the regulator reach either of its end positions the motor is prevented from rotating any further, but it is so arranged that the motor can operate in the opposite direction if any alteration in the pressure takes place.—London *Electrician*, Feb. 19, 1915.

Control Gear for Swing Bridge.—An illustrated article on the opening of the swing bridge over the Forth and Clyde Canal at Dalmuir, Glasgow. This is believed to be the first movable bridge in the world where the whole of the operations of opening and closing the bridge, as well as the control of the pedestrian, vehicular and water-borne traffic, can be performed electrically by one man from one position. The construction of the switchboard is described in some detail and illustrated. —London *Elec. Eng'ing*, Feb. 12, 1915.

Wires, Wiring and Conduits

Wiring.—H. C. TOFIELD.—A continuation of his illustrated article on modern wiring work, particularly in bad situations. In the present instalment the author describes a corrosion-proof junction box.—London *Elec. Review*, Feb. 12, 1915.

Electric Wire and Cable Terminology.—An official circular of the Bureau of Standards giving definitions and illustrations of the following terms: Wire, conductor, stranded conductor, cable, strand, stranded wire, cord, concentric strand, concentric-lay cable, rope-lay cable, *N*-conductor cable, *N*-conductor concentric cable, duplex cable, twin cable, triplex cable, twisted pair, and twin wire.—*Circular Bureau of Standards*, No. 37, Jan. 1, 1915.

Electrophysics and Magnetism

The Electrostatic Intensity on a Conducting Sphere in a Uniform Field of Force.—GEORGE R. DEAN.—The solution of this problem by the method of images is given in several textbooks on electricity and magnetism. In the present article the problem can also be solved by adjusting solutions of Laplace's equation to certain boundary conditions. The process is given as an example of the use of harmonic functions.—London *Electrician*, Feb. 5, 1915.

Photo-Active Cells with Fluorescent Electrolytes.—GEORGE E. THOMPSON.—The efforts of previous experimenters to prove a dependence of the photo-electric current on fluorescence, in the case where two metal electrodes immersed in certain fluorescent solutions are unequally illuminated, have not led to definite results. The present author's investigation was undertaken to discover additional facts which have a bearing on the subject. The chief results are as follows: The curves for the growth and decay of the photo-electric current are similar to those for the growth and decay of phosphorescence. The magnitude of the photo-electric current depends on the metal used as electrodes. Of ten metals tried, only platinum, gold, silver and oxidized copper gave a measurable effect. The position of the maximum effect does not depend upon the material of the electrodes but upon the material in solution. The effect is not the photo-electric effect of the metal in the liquid. The experimental results do not show any close connection between the photo-electric current and fluorescence. Two methods of increasing fluorescence did not increase the current. The region of excitation for the current extends further into the red than for fluorescence. All of the curves show the maximum photo-electric current approximately in the region of maximum absorption.—*Physical Review*, January, 1915.

Units, Measurements and Instruments

Roentgen-Ray Examination of Engineering Materials.—C. N. MOORE.—Until recently the Roentgen-ray tube has been used chiefly in medicine and surgery. The Coolidge tube, however, has broadened the scope of the application of Roentgen rays and is now being used for the examination of materials for engineering purposes, like the examination of steel castings and copper casting as to internal defects, blow-holes, etc. In the present article the author describes how the Coolidge tube may be used for the Roentgen-ray inspection of built-up mica. The article is illustrated by numerous radiographs.—*Gen. Elec. Review*, March, 1915.

Kenotron—A Hot-Cathode Rectifier.—S. DUSHMAN. —An exhausted tube containing two electrodes, one of which is heated by some external source, acts as a rectifier. When the heated electrode is cathode only, a thermionic current passes. For a given voltage drop this thermionic current increases with the temperature, but above a certain temperature the current becomes constant. On the other hand, for a given temperature

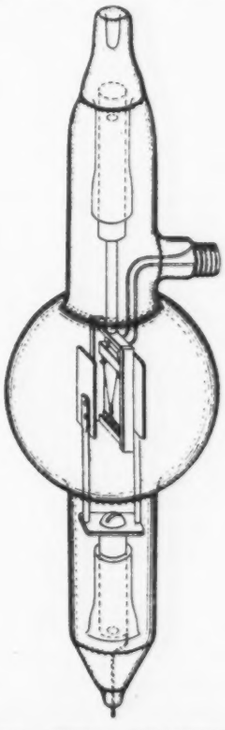


FIG. 2—KENOTRON WITH FILAMENT BETWEEN TWO PARALLEL PLATES

of the cathode the thermionic current increases at first as the positive potential on the anode is increased, but finally a saturation thermionic current is obtained and further increase in voltage has no effect. With a sufficiently perfect vacuum this thermionic current is due to a pure electron emission. The kenotron is a rectifier based on this phenomenon, and the author discusses how the design depends on the amount of current to be rectified, the maximum permissible voltage loss, and the proper form of electrodes to prevent electrostatic strains on the filament. The author describes three different forms of kenotrons. The first type contains a molybdenum cylinder and a coaxial filament and is suitable for alternating-current voltages up to 15,000 and a current of 400 milliamperes and voltages up to 100,000 and a current of 100 milliamperes. The efficiency of this rectifier is between 98 and 98.75 per cent. A second type of kenotron, which is suitable for voltages not over 10,000 and currents ranging up to 100 milliamperes, contains a small filament such as is used in automobile headlamps inserted in a molybdenum cap about $\frac{5}{8}$ in. in diameter. A third type is shown in Fig. 2. It contains a V-shaped filament between two tungsten plates.

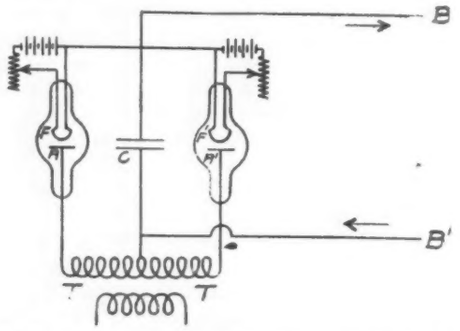


FIG. 3—ARRANGEMENT FOR RECTIFYING BOTH HALF WAVES

In one form the plates are 2 cm apart, in a second 4 cm. In the first the filament is 6 cm long, in the second 7 cm. The first can be used up to 40,000 volts, the second to 60,000 volts. Oscillograms of the performance of kenotrons with alternating-current voltages are given. In the physical laboratory, where small direct-currents of a few milliamperes at very high voltages are required, as for spectroscopic work, operating small discharge tubes, etc., the kenotron is exceptionally useful. An arrangement similar to that shown in Fig. 3, and consisting of two kenotrons of the headlamp-filament type with a 60:1 potential transformer, is a satisfactory source of direct-current voltages up to 4500 or 5000. By inserting a condenser C of sufficiently high capacity between the terminals BB' the direct current may be made as free from pulsations as desired. The kenotron may also be used for testing the dielectric strength of insulation with high-voltage direct currents. The combination of kenotrons and transformer may replace the cumbersome static machines and the still more complicated mechanical rectifiers that are at present used to produce high-voltage direct current for X-ray tubes and the precipitation of dust, smoke, etc. The kenotron may also be used for high-voltage direct-current transmission. "To transmit 1000 kw by 100 kenotrons, working in parallel at a voltage of 50,000 to 75,000, is quite a feasible proposition."—*Gen. Elec. Review*, March, 1915.

Telegraphy, Telephony and Signals

Automatic Telephony for Private Buildings.—KARL SCHEIBE.—An article on the use of automatic or semi-automatic systems in private telephone exchanges in large office buildings, etc. Several special viewpoints are discussed which should be taken into consideration whenever such an exchange is being planned.—*Elek. Zeit.*, Jan. 28, 1915.

The Loaded Telegraph Cable.—H. W. MALCOLM.—A continuation of his long serial on the future outlook of cable telegraphy. The author takes up the mathematical discussion of the loaded telegraph cable. He first gives the formula for a single inductive mesh, for two inductive meshes, for three inductive meshes, and for four inductive meshes, and indicates how the generalization may be reached for an infinite number of meshes. The serial, which is highly mathematical and which is illustrated by numerous diagrams, is to be continued.—London *Electrician*, Feb. 19, 1915.

Conditions Affecting the Variations in Strength of Wireless Signals.—E. W. MARCHANT.—A continuation of a paper read before the (British) Institution of Electrical Engineers. After discussing the methods employed in measuring the variations in strength of wireless signals, the author describes in detail the results of his experiments. These show that the greater variations in signal strength occur at night and are controlled by the state of ionization of the atmosphere. The paper is illustrated by numerous diagrams.—London *Electrician*, Feb. 12, 1915.

Miscellaneous

Electricity in the German Post Office Department.—KASTEN.—The first part of a detailed illustrated description of the use of electricity for handling mail and parcels by the German Post Office Department, especially in the railway stations.—*Elek. Zeit.*, Jan. 28, 1915.

In the Days of Watt.—J. D. CORMACK.—The James Watt anniversary lecture delivered to the Greenock Philosophical Society, in which the author gives an account of the life and work of James Watt.—London *Engineering*, Feb. 5, 1915.

Canada.—An article giving statistical data on the importation into and exportations from Canada of various electrical machinery and apparatus during the last year and comparative figures with the preceding year.—London *Elec. Review*, Feb. 12, 1915.

Book Review

ELECTRIC LIGHT FITTING. By S. C. Batstone. New York: The Macmillan Company. 318 pages, 238 illus. Price, $1.50.

As its title suggests, this book deals largely with detailed descriptions of wiring devices such as conductors with their insulation, switches, distributing boards, protective devices, etc. The chapters on methods of laying out and installing wiring systems are valuable, but all tables and data, together with rules and regulations governing electrical installations, are in accordance with British standards, so that the book is of only limited use to the American reader. In the introductory chapter the hydraulic analogy is freely used in explanation of the laws of the electric circuit, but the author is inaccurate in his use of the term "inductance," which he repeatedly uses as if synonymous with reactance. The book may be further criticised because of the attempt made to cover a very wide field. The result of the attempt to treat of meters, arc and incandescent lamps, shades and reflectors, private power plants and central stations, in addition to fittings for wiring installations, all in the one volume, is to make the additional chapters of comparatively little value to either the student or the practical electrician.

POWER AND OPERATING SECTION

Electricity in Industrial Service

IN the last decade there has been a surprising increase in the use of steam engines, an index of the growth in manufactures. Gas and oil engines have shown a large percentage increase, but in absolute horse-power the amount is not large. Hydraulic developments have gone on at no great pace, but very steadily, slowly working up the resources of the country, while the use of electric motors in the function of prime movers for manufacturing purposes has increased very greatly, probably at a materially greater rate than has the use of steam engines. In other words, the indications are that the electric motor is gaining without having yet anywhere nearly come into its own in the displacement of steam. Electric service has made an excellent showing, and unless all the signs of the times are going wrong it will make a much better showing in the next five years than it has in the past, owing to the great success of electricity in covering territory hitherto not well served and bringing to the manufacturer the benefits of a cheap service independent of the location of his factory.

Safety and the Individual

MORE than passing comment and consideration belongs to the "safety first" plan which the Commonwealth Edison Company has been carrying out for more than a year. Going a step further than mere mechanical safeguards and physical precautions, of which liberal use had already been made in the company's stations, the officials of that company inaugurated a plan of reaching directly the individual employee with safety instructions, and thus developing each man's own sense of responsibility and carefulness. Analysis of the accident records of the company had revealed the fact that the electrical hazards of the business contributed only a few per cent to the injury toll, while by far the largest class of accidents involved such common cases of carelessness as falls, the dropping of tools and materials on fellow workers, use of unsubstantial structures, etc. Hence, while continuing the placing of physical safeguards as before, it was determined to bring about greater vigilance for safety on the part of the men themselves, and to this end a safety body was formed within the company, to include every individual of that great central-station organization. Each employee has thus become a member of a safety committee and shares the sense of responsibility which the appointment implies. The results have exceeded all expectations, for the number of accidents has been reduced by 50 per cent, while the time lost per employee for the past year was about one-sixth of that for the preceding twelve months. Apparently, a great idea, a fundamental principle of accident prevention, has been discovered and put to work. Like other great conceptions, it is simple, and its execution demands the minimum of outlay or equipment. It fits the conditions of large and small organizations alike. Its doctrine may be made the means of augmenting the interest and self-respect of the individual employee and the *esprit de corps* of the organization. And, above all, in application it has proved effective, to a degree heretofore unequaled, in minimizing the toll of accidents and injuries among the men imbued with its spirit, to whom "safety first" has now become a very real and very personal ideal.

Prime Movers in the United States

A BRIEF article by Messrs A. A. Potter and W. A. Buck in this issue contains some striking data relating to the various classes of prime movers used in the power plants in this country. Perhaps the most interesting single figure given is that representing the aggregate horse-power of steam engines in use, over 14,000,000 at the date of the last census, probably 17,000,000 or 18,000,000 now. Gas and oil engines represented only about 750,000 hp, or 4 per cent of the total power of prime movers in 1909. No exact data for correcting this figure to the present time are available, but it is somewhat doubtful whether the percentage has increased. Waterwheels have shown a relatively slow but steady increase and may perhaps be estimated at nearly 2,000,000 hp at the present time. Electric motors considered as prime movers—that is, as the direct power supply of industrial establishments—are still more difficult to evaluate in amount. From the figures given by the authors, the totals should have risen by this time to something over 3,000,000 hp exclusive of railway motors; at all events, it is very certain that the relative importance of the electric motor as a prime mover has relatively increased during the period since the last census. The figures quoted pertain wholly to manufacturing establishments, not including electric generating stations. With respect to these the figures are most striking. The total steam horse-power used for central-station purposes, including railways, was over 8,000,000 in 1912, and now must be well up to 9,000,000. In other words, of the total steam horse-power in the United States at least a third is used in electric generating stations of one sort or another. In actual output the railways show somewhat over one-third of the total for all electric stations. Of the steam prime movers the turbine has altogether the advantage in output, representing to-day something like two-thirds of the total steam equipment rating.

Efficiency in Boiler Management

Twenty years ago the possession of an indicator outfit and the ability to use it accurately and intelligently constituted a sort of badge of distinction among operating engineers. To the uninitiated there was something dark and mysterious in being able to determine, from the mere inspection of an irregular outline traced on a slip of paper, the reasons for the faulty and uneconomical working of a steam engine. As a consequence the indicator became an exceedingly popular instrument among the engineering fraternity, and for a time it seemed as though all efforts to increase the economy of steam-power plants were centered on improvements in steam distribution, unmindful of the fact that opportunities for effecting savings are always largest at those places where the wastes are greatest. It is significant that in recent years the attention of engineers has been turning with rapidly growing interest to the losses that occur in connection with the generation of steam.

The effect of the present trend of investigation toward the combustion chamber and the coal pile has been to introduce into the boiler room appliances that had heretofore been used only in laboratory experiments or in commercial testing of plants. The draft gage, the recording thermometer for taking flue-gas temperatures, and the carbon-dioxide recorder for showing continuously the state of combustion in the furnace have become part of the regular equipment in many plants. These devices bear the same relation to the efficiency of combustion in the boiler that the indicator bears to the performance of the steam engine; that is, they serve to indicate where the loss-producing faults lie and thereby enable steps to be taken to avoid such losses. Some truly remarkable savings have been effected by changes in the draft and the air distribution based on data obtained by the use of the devices named.

Aside from the immediate betterment of combustion the installation of the above-mentioned instruments had a marked effect on the firemen. The readings of the instruments were a check on the efficiency with which each man tended his furnaces, and so each one was brought face to face with the problems involved in the chemistry of combustion, opening a vista of new and interesting fields of study to the ambitious fireman. In some plants bonus systems have been adopted whereby increased pay is given to the firemen for maintaining conditions above a certain fair standard. In other plants the bonus is a percentage of the value of the coal saved by more efficient regulation of the furnaces. In view of the fact that the coal bill represents from one-fourth to one-half of the total operating expense of the plant, and that the losses in steam generation vary from 20 per cent to 40 per cent of the heat in the coal, there is ample opportunity for the wide-awake fireman to reduce the running expenses. At any rate, it is safe to predict that with the increasing use of instruments that show the conditions under which furnaces are working there will be a corresponding improvement in the efficiency of the boiler-operating force.

Explaining Stand-by Service to the Public

In an Eastern municipal plant which purchases energy a part of the time from a hydroelectric system traversing the valley in which the town lies considerable uneasiness was manifested not long ago by some of the taxpayers because the plant was frequently shut down for considerable periods while the demands of the community were met by the outside energy. There was a feeling abroad that because the local plant was not running steadily a substantial share of the funds contributed by the citizens to electric-service facilities was being wasted. In this rather amusing instance the operating conditions under which both the local steam plant and the hydroelectric station did profitable business were in no sense comprehended by the taxpayers, who became restive under the long-continued flow of energy from the outside company into the municipal network of distribution lines. The case was obviously one for popular educative treatment, and while objections of this sort may perhaps be made now and then for political effect where electricity is purchased on advantageous terms when the water supply of the hydroelectric company is ample, they are not often encountered.

The circumstance does emphasize, however, the desirability of doing everything possible to make clear to the public the reasons why at times such a plant can be more profitably "run at a standstill," to adopt a Celtic idiom. Even after many years of central-station service the existence and functions of the load curve are practically unknown to a vast number of consumers and citizens who have never had any of these things explained to them. This may be no fault of the local management, but we are inclined to think that on some of the occasions where a company is making liberal use of local newspaper space it will pay to print a simple load curve, showing the station output from hour to hour, the number and size of machines in service at different times, and, where energy is purchased on the peak or otherwise, indicating by shaded areas what part of the output to the local system comes from outside sources and what part is generated at and distributed from the local station.

The going into and out of service of each generator easily can be shown by parallel horizontal lines broken where shut-downs occur and just below the abscissas hours of the day. It is surprising how quickly many laymen can be brought to see points of this kind by simple graphic methods, coupled with short and pithy explanations. Certainly it is desirable that the public in general shall have some conception of the cost of being ready to furnish service at all hours, and the broad economic advantages of using a municipal plant as a stand-by in connection with a private hydroelectric system ought to be made apparent without any serious difficulty. In most cases the difficulties come in drawing up the motor-service sales agreement between the municipality and the company, and not in the practical operation of the combined system or working out of the contract entered into.

Substations for Industrial Plants

Standard Arrangement Adopted by the Union Electric Light & Power Company of St. Louis for Large Electric-Service Customers Using Twenty-five-Cycle Energy

WITH the advent of Keokuk hydroelectric power in St. Louis, Mo., some of the larger customers on the lines of the Union Electric Light & Power Company took advantage of the opportunity to reduce their bills by installing high-tension twenty-five-cycle service. For the benefit of these customers, and to standardize, in a measure, various types of customers' substations, the central-station company has prepared specifications considered desirable for such installations. Several substations have already been built along these lines, and a description of these buildings and their equipment illustrates the general practice followed.

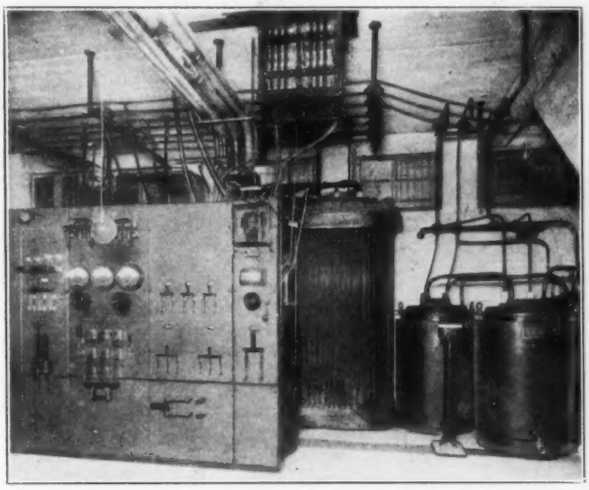


FIG. 1—CENTURY ELECTRIC COMPANY—SWITCHBOARD AND TRANSFORMERS

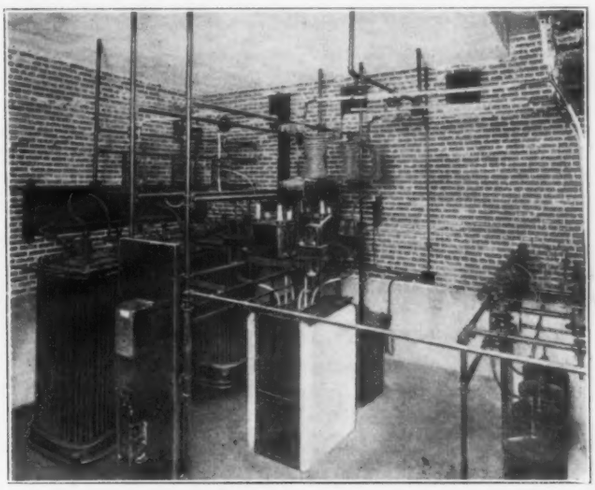


FIG. 3—AMAZON RUBBER COMPANY—TRANSFORMERS, OIL SWITCHES AND LIGHTNING ARRESTERS

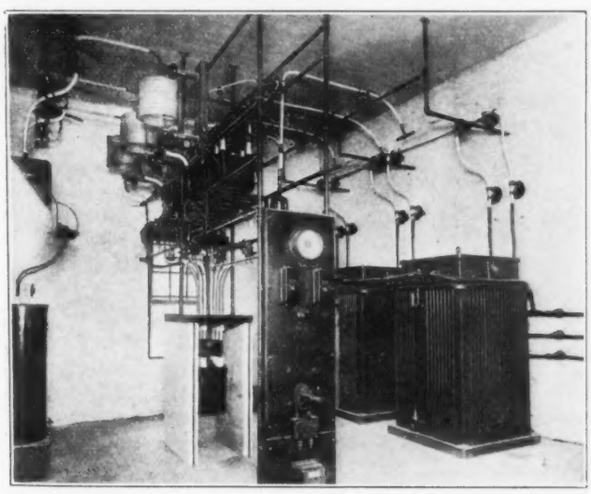


FIG. 4—BURLINGTON GRAIN ELEVATOR COMPANY—PRIMARY SWITCHING AND TRANSFORMER EQUIPMENT

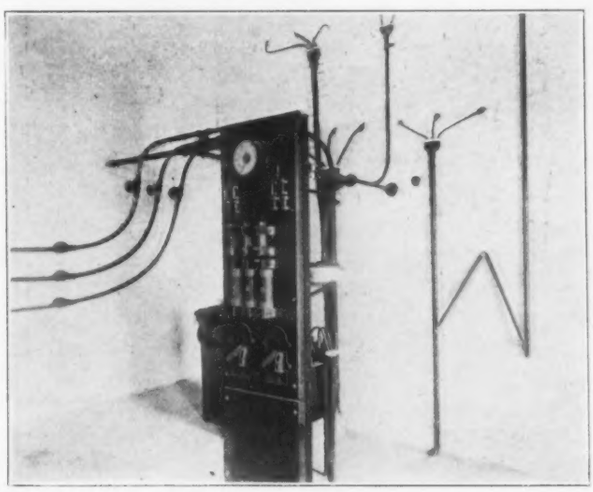


FIG. 4—BURLINGTON GRAIN ELEVATOR COMPANY—SECONDARY SWITCHBOARD PANEL

It is recommended, first of all, that customers' substation equipment be housed in buildings of practically fireproof construction. As a rule the 13,200-volt lines enter the building through 25,000-volt bushings, pass through knife-blade disconnect switches and choke coils, and are then led to the (nominal) 15,000-volt hand-operated automatic oil switch. This oil switch should be mounted in a concrete or brick compartment with an asbestos-board door. In all cases it is advised that the switch be installed at a distance from its controlling panel and that it be operated by a handle mounted on the switchboard panel some distance away. From the oil switch three-phase buses lead to the transformers. All high-voltage wiring is thus kept well out of reach.

For average installations not exceeding 1000 kw in size it is recommended that the primary wiring consist of No. 0 solid copper wire insulated with varnished cambric and covered with flame-proof braid. This wiring is mounted on 15,000-volt insulators. Wire of No. 0 size is chosen because of its mechanical strength, which assures a neat, stable and workmanlike job. Solid wire is preferable to stranded cable because the solid conductor will not sag.

To afford proper protection to all substation equip-

ment, lightning arresters are connected to the lines ahead of all other equipment except the disconnecting switches, which are mounted immediately beneath the terminals of the roof-entrance bushings. By opening these disconnecting switches it is possible to de-energize all live circuits in the substation except the roof bushings at the ends of the incoming wires. The lightning arresters are generally surrounded by protecting screens, since in most cases the tanks of the arresters are "alive" when in operation. Ample clearance in all cases is provided above the horns of the arresters. No inflammable material is allowed near the horns, since an arc due to lightning is likely to rise 2 ft. or more above the extremities of the horns. An established rule is that no one shall be permitted to work on any high-voltage apparatus while it is "alive." No one but the customer's electrician and his assistants familiar with the equipment is permitted to enter the high-voltage portion of a substation.

The instrument transformers are usually connected to the primary wiring above the oil-switch structure in such a manner as to be well out of reach. The secondary wires from the instrument transformers are run to the switchboard panel, either in separate iron conduits or through the iron-pipe supports above the oil-switch structure. Indoors all 13,200-volt wires are spaced at distances of not less than 18 in. Spacing barriers of asbestos board or slate are recommended between blades of disconnecting switches.

Arrangement of Transformers and Buses

Where there is more than one bank of transformers it is considered preferable to install one main-line oil

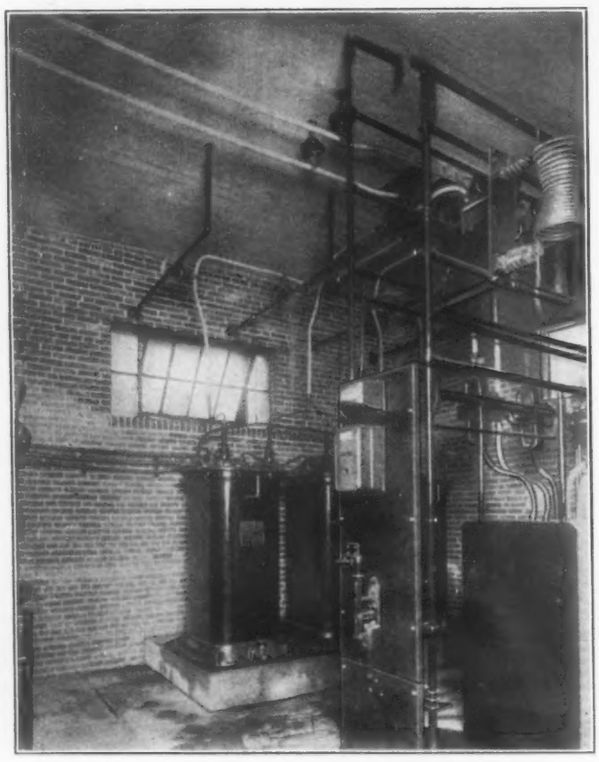


FIG. 5—MANUFACTURERS' RAILWAY COMPANY—TRANSFORMERS AND PRIMARY SWITCHING EQUIPMENT

switch and one oil switch for primary connection to each transformer bank. A set of buses is then established over the oil-switch structure, and knife-blade disconnecting switches are placed between all oil switches and buses. Unless space limitations preclude it, three single-phase transformers are used instead of one three-phase transformer, since with a delta-connected transformer bank it is possible to continue operations with two transformers in case of the failure of one unit. It is also considered good practice to have each of the transformers of such rating that two of them will carry the load in case of the failure of the third. It is recommended that oil-insulated, self-cooled transformers be used in sizes up to 300 kw per transformer.

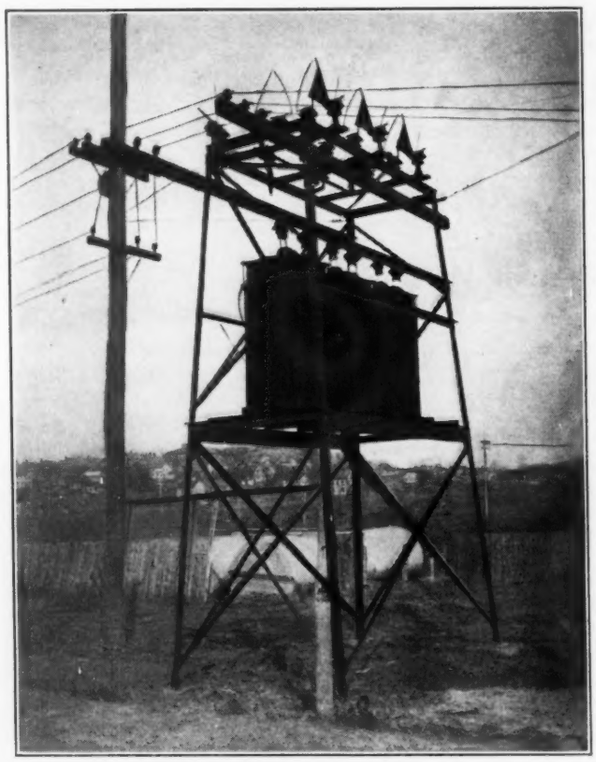


FIG. 6—OUTDOOR TYPE OF SUBSTATION

The handling of the secondary circuits of transformers in these switches depends, of course, very largely upon the requirements of each case, and recommendations are made to suit local conditions.

Rapid Construction of Street-Lighting System

During the period of construction of the new street-lighting system at Indianapolis, Ind., work was pushed with such vigor that records for the speedy erection of material were established and broken time after time. The working force consisted of sixteen line gangs, each composed of six linemen, seven groundmen and one foreman. In addition to numerous wagons and trucks four pole derricks were used. On the average this force of men put cross-arms on and set 180 poles a day, and the maximum day's work consisted of cross-arming and erecting 275 poles. All of the poles were of Western cedar with 8-in. tops and ranged in height from 35 ft. to 60 ft.

While stringing wire the crew's average day's work consisted of putting up 5 tons of No. 6 triple-braided weatherproof copper wire. The greatest amount of wire put up in any one day was 7.5 tons. These figures include only the wire put up and tied in on the white porcelain insulators which were used, and do not indicate merely wire strung. The electrical construction at Indianapolis was carried on under the direction of Mr. A. J. Goedjen, electrical engineer for the Merchants' Heat & Light Company.

Diesel-Type Oil Engine in European Repute

Its Acceptance as an Established Form of Prime Mover—How General Confidence Is Overcoming Individual Prejudice

BY R. W. CROWLY

NOWADAYS the European engineer who from ingrained prejudice and studied ignorance professes to doubt the capacity of the Diesel-type engine for hard, enduring service finds it impossible to maintain that attitude without being forced into the position of a self-confessed bigot. All around him to-day the evidence of numerous Diesel-type engines performing their allotted industrial service is insistent, and his sincerity is measurable by the use he makes of these opportunities to inform himself of the specific behavior of this class of machinery. If he examines the evidence, he becomes a convert; if he professes distrust and refuses to probe the controverting facts brought up before him, he arraigns himself as a bigot. It is not possible for a man to investigate the performances and achievements of the modern four-stroke-cycle Diesel-type engine without being overwhelmed by the conviction that it is at least the equal in trustworthiness, durability and service efficiency of any other prime mover, and in certain respects the superior.

Circumstances prevail against the American engineer, even in the best of times, preventing him from obtaining access to this wealth of evidence. These installations are not at his door; they are thousands of miles away. Scattered up and down the countries of Europe, they are hidden from the stranger, unadvertised, not forcing themselves to notice. Intent generally upon seeing the greater establishments, the visitor to Europe can touch but lightly upon the Diesel power plants. He may visit the factories where these engines are being constructed in large numbers and may be impressed by the silent testimony of the rows upon rows of cylinder columns, base-plates and other parts making their way to, and standing in, the erecting shops. He may pass from one famous factory to another and have it borne in on him that there is a vast outpouring of this high-grade construction; he may call here and there at one of the better-known stations where Diesel machinery is installed; he may hear of all the great work progressing along this line; but he misses, and must miss, the greatest lesson of all, the lesson of daily acquaintance with the regular, uninterrupted operation of many Diesel plants.

Great Variety of Diesel-Engine Installations

No words can carry the conviction of that acquaintanceship. It seems bald to state that I have lived where within 30 miles I could, and used to, chat with a dozen different superintendents of Diesel power plants, and that very, very seldom was there anything to discuss about their engines. Yet that bald statement enfolds an experience which, if parceled into fractions and distributed at random to owners of power plants, would continue to influence the adoption of Diesel engines for a long while to come. There is almost an air of banality in the assertion that I have been in textile mills, railroad shops, leather factories, engineering works, etc., where the whole activity of the place was dependent upon these oil engines. Yet that banal assertion concentrates within itself the story of some achievements that no other form of prime mover than the Diesel engine could have accomplished. For eleven years I was in and out of an establishment where a Diesel engine carried the whole load and failed only once in all that time. From friends in charge of Diesel plants too remote for me to visit more than once in a while I have known the good service of many another installation. Nearly all over Europe, not once but many times, have I seen these engines at work under widely different circumstances and in charge of all sorts of men. From France to Russia and from Italy to Sweden, in ten different countries, have I learned what this machinery does in service. Such intimacy gives a surpassing confidence in this type of engine, but it is an intimacy out of general reach. A much lesser acquaintanceship suffices to instil confidence. Perhaps the recital of some outstanding examples of that spirit in Europe, the presentation of some individual cases of its influence, and an indication of how the weight of evidence is gradually overcoming the last prejudice over there, may point the way to a better appreciation of the engine in this country.

As premise, let it be understood that, except where the contrary is expressly stated, only the four-stroke-cycle type of engine is taken into view. This is the well-tried form, the fully developed form and, for stationary plants, the almost universal form up to 1000 hp. The two-stroke-cycle engines are a subject in themselves, to be treated separately and to be considered on a different basis.

Achievements in Russia

So seldom does one turn to Russia for examples of modern engineering that an engine performance meritorious in itself becomes more telling when recorded from that country. I have seen there an 800-hp Diesel-type engine which had been running continuously day and night for eleven months with only a half-hour rest every Sunday while valves were being changed. It was in the Peroon Works, Petrograd, where conditions had suddenly arisen to render that engine the only prime mover available. So marked had been the economy of this engine that the directors had resolved to duplicate it, and at the time of my visit the erection of the second engine had been commenced, the only difference between the two sets being that the later one was of Russian construction whereas the first was German-built. From February of that year until December the works had been dependent entirely upon the power developed from those four large cylinders, 24 in. in diameter, a trust which had never been imposed in the earlier steam plant. That was a remarkable performance which deserves to become a classic instance.

In its way the Diesel-engine installation at the Göggnigen Cotton Mills, Bavaria, affords an even more striking example of implicit confidence in this style of machinery. At the Peroon Works, just cited above, the dependence upon the single engine was accidental, the boilers of the steam plant having been suddenly condemned, but at Göggnigen the reliance upon a solitary set is deliberate, and there is not even room for reserve machinery in the present-day lay-out. A two-throw, four-cylinder tandem double-acting engine of 1200 hp supplies the power in these mills: no electrical supply is at hand for emergency, and in the event of a breakdown the mills would be closed. Without a trace of distrust or suspicion, but on the contrary with proud and triumphant confidence, this firm has boldly tied up its whole activity not merely with Diesel machinery but

with a single set of such machinery. The simple logic of the superintendent is irresistible. "It required only one steam engine to run the mills," he says; "why should it need more than one Diesel engine?" Incidentally, it may be observed, this installation is most comprehensively efficient. The circulating water from the cylinder jackets is led away for use in the color tanks, and the exhaust gases are utilized to heat clean air for the drying rooms, an aggregate of 84 per cent of the total heat of the oil fuel thus being converted to useful purpose.

Bavarian Installations

Bavaria, as befits the native country of the Diesel engine, can show many very fine installations of this class, varying from 20 hp through the whole range to 1200 hp. It was in this part of Germany, in Augsburg to be precise, that I saw an 850-hp Diesel engine taking the load in a trolley-car generating station. Such a load in a small town is very variable, the changes being both sudden and considerable, but the Diesel-type set was working very nearly as steadily under those circumstances as under a constant load, the fluctuations being almost unnoticeable on the tachometer. There is, of course, a reason for that, the action of the governor on the separate fuel pumps obtaining instant adjustment of the fuel charges to suit the load. Day after day the load was thrown upon the oil engine, and the steam plant was held in reserve, its economy on this fluctuating service being inferior to that of the Diesel machinery.

Only last summer there was completed at Liverpool, England, the largest graving dry-dock in the world, the Gladstone Dock, 1000 ft. long and capable not only of taking the greatest liners of to-day but of anticipating the probable requirements of the future largest liners for some years to come. The call for such a dock is infrequent, but when it is made it is urgent because of the capital represented in these great liners, a huge sum, which must not be allowed to remain idle. Moreover, economic conditions dictate that such a dock can be accessible for its greatest capacity only on top of the tide. To pump out the millions of gallons of water contained in a dock of such volume must therefore be a certain as well as a quick operation. For that purpose Diesel-type engines were selected by the Liverpool engineers, five sets of 1000 hp being installed, capable of emptying the dock in three hours. In this particular instance the conditions were not unfavorable to two-stroke-cycle engines, and this class was adopted.

American engineers apparently are not familiar enough with oil-engine power to intrust such an operation to it, but the day when they will be prepared to do so is steadily drawing near. Big Diesel-driven pumping plants are tending to become as common as the big Diesel electric installations, and the tendency is manifest through four continents. In the waterworks at Bremen, Germany, there is to be installed an aggregate of 6000 hp in Diesel-type machinery, half of this power being in one two-stroke-cycle set. For the big Nile Delta drainage scheme, which in comprehensiveness and extent is to be one of the notable drainage works of the world, the order has fallen to Diesel engines. The corollary of the Nile barrage development, which holds up the water for the irrigation of great tracts of Upper Egypt during the dry season, the Delta drainage scheme, is planned to render the cultivation possible of the rich alluvial soil of the Nile mouths. Twenty-four 300-hp Diesel pumping sets were envisaged by the first requirements and have been contracted for, but before this latest plan of Lord Kitchener's for the development of Egypt is completed many more Diesel sets will be sent to that country.

Diesel Electric Plants

Perhaps more striking are the orders in hand and completed for powerful Diesel electric plants. About eighteen months ago I saw under test in Amsterdam the second of five 1100-hp, six-cylinder Diesel alternator sets for Billiton, Dutch East Indies, to supply power, if I recollect rightly, in one of the famous tin mines of that part of the world. In the great shipyards and engine works of Harland & Wolf, at Belfast, Ireland, where the leviathans of the White Star Line first take shape, there is to be erected a six-cylinder, 4000-hp Diesel generating set, but I must admit there is reason for believing this large two-stroke-cycle engine to have been ordered chiefly for observation of the troubles to be expected in powerful machinery of this particular class. The installation should have been completed at this date.

At Calais, the French gateway for a large part of the passenger traffic across the English Channel, there is a big generating station where Diesel engines of 1000 hp have been operating for about three years past. This is adjacent to the coal fields of Northern France, yet an extra 3500 hp is to be supplied there by Diesel engines in two-stroke-cycle sets. Double that power has been ordered in a single contract for London, England. At Naples, Italy, a Diesel plant aggregating over 4000 hp is to be installed. And in Hong Kong, the clearing-house of the Far East, which annually enters a tonnage exceeding that of any other port in the world, 3500 hp is to be furnished by Diesel machinery.

These facts and figures should inspire confidence. Every one of the engineers responsible for these installations has had to gain confidence. Not one of them was born to the Diesel-type engine as he was to the steam engine. The engineers of this generation came into a world where steam-power seemed as much in the order of nature as the mountains and valleys. They had not to question it; the puff of the railroad locomotive was one of their first childhood attractions. Around them, as they grew up, they saw everywhere the use of steam for power. Such lifelong familiarity breeds a very deep-rooted kindliness toward steam. The Diesel-type engine, on the other hand, coming in at a later date, offering to do the work of this old friend, has frequently been regarded as an interloper and consequently met with a chilly reception. It has always had to ingratiate itself, a difficult task when a frown instead of a welcome is awaiting. Against such obstacles has it had to instil confidence, and the extent of its adoption through the world shows its capacity for making friends when the doors are not shut against it.

Diesel Engines in America

That the engineers of America are gradually becoming imbued with a kindlier feeling toward this class of machinery is evident from such orders as the 1500-hp contract for Diesel-type engines to be installed in the Paris (Tex.) station of the Texas Power & Light Company, and the 1000-hp contract for similar engines for Arizona. These are significant of confidence. Acquaintance with the engine is the need in American engineering circles to-day.

Many instances of the conversion of whole-hearted steam engineers on the other side come into my mind, and examples of prejudice so deep rooted as to survive familiarity with the engine enter also into recollection. Of these a few cases will serve to illustrate the sentiment. The superintendent of a central station not many miles from London had practically decided to install a steam turbine for the much-needed enlargement of his plant, when he was prevailed upon by a neighboring superintendent to make a round of visits to various Diesel power houses. Among the plants recommended

to him were several where a Diesel-type engine was the sole prime mover and where there was no stand-by set. These were the examples, he assured me later, which killed his distrust in the type, and when therefore he figured out that Diesel machinery would earn an appreciable saving he had no hesitation in contracting for 1000 hp of such oil engines. The steam plant totaled about 2000 kw, and in the result, as had been anticipated, with slack coal at $3.50 per ton and fuel oil at $17 per ton, there was considerable economy in running one of the Diesel engines throughout the twenty-four hours, assisting it through the daytime with the other oil engine and using the steam sets only to work over the peak. This superintendent had been regarded as one of the quite uncompromising steam devotees.

Another such instance that caused comment at the time was associated with one of the railroads. At the time when an investigation was being made to determine whether the lines of shafting in the wagon and carriage works could profitably be superseded by individual electric drive a new power house was taken into consideration. One would not be astonished if such extensive users of steam-power as the railroads are should have considered only steam for this installation. The electrical engineer of the company, however, made out figures for oil engines also and was surprised to find that on a 1000-hp plant he would save $10,000 per annum, with coal at $5.50 and fuel oil at $16.50 per ton respectively. It was then that he had to consider whether Diesel engines were reliable enough. His subsequent decision is highly interesting because of the manner in which he arrived at his conviction. He satisfied himself that Diesel machinery was being used to an increasingly large extent and, reflecting that the aggregate horsepower amounted to a figure which would not have been attained if this style of engine had remained experimental, he proceeded to order a couple of 500-hp engines from the first firm of good repute, without bothering himself to examine the variations characterizing the designs of the different constructors. There was a clear case of immediate conviction. In this instance, as in the previous one, the machinery has been laid down within the last twelve months at Kingston and Eastleigh respectively, in England.

Survival of Prejudice

On the other hand, there are a very few men who never become wholly habituated to the idea of the Diesel engine, even after experience of it. One such I know has had a Diesel set in his central station for over two years and has never had any trouble with it. Yet he persists in expressing a dislike for it, and, when questioned, avers that he is sure it will one day give up work when he least can spare it. Another chief engineer, who has five Diesel sets in substations, expresses a profound hatred for the type, and gives voice to a regret that he will be obliged to have more sets of this character, which are to him indispensable owing to the local prevalence of sudden sky fogs. It may be that the attitude is affected, but it is nevertheless occasionally encountered, and it has seemed of interest to mention it here because of the insight it gives into the overruling spread of the Diesel cult even where prejudice and conservatism are most pronounced.

Enlightenment of a more inspiring character can be drawn from the increasing favor shown toward the Diesel-type engine for service in out-of-way corners of the earth. With what unconscious perversity the inborn prejudice of the unconverted engineer tinges his outlook upon this type of prime mover was once again demonstrated to me in this very connection. It was urged that these distant and inaccessible plants were ordered by men too far from the great industrial centers to have knowledge that the Diesel engine's claim to attention was really one of theoretical value and not of practical worth. Apart from the absurdity of the assumption that the engine is not trustworthy, this argument was fallacious in that the supply of power equipment to the back of the undeveloped continents is one of the richest branches of the trade of the merchant princes and of the great contracting firms. Houses like those of Matheson & Company, Grace & Company, Pearson & Sons and White & Company order through London what amounts to a considerable aggregate of Diesel horsepower during the year. Through the great export houses of Amsterdam and Hamburg flows also a large Diesel business. These are the engines that go to the cotton mills of India, the mines of the Malay States, the refrigerating plants of Java, the oil fields of Sumatra and Borneo, the canning factories of New Zealand, the water-works of Australia, the generating stations of South America, and to a thousand and one other purposes in remote regions. These installations are not the outcome of individual whims—they are the result of a settled policy based upon an experience of success. They are a tribute to the service efficiency of the Diesel-type engine, and a tribute that is noted by discriminating men. The effect is seen in a specification like that of the Australian Commonwealth government requiring tenders for the power plant of its powerful station in the British imperial wireless chain. At Port Darwin, in the desert north of that great island continent, thousands of miles from any settlement that could boast of a pretence to engineering conveniences, and so unfriendly that the coasting steamer has to stand a couple of miles off shore and unload into small boats, the Commonwealth government was calling for one 800-kw and two 500-kw Diesel generating sets to furnish the power for wireless communication over the huge wastes of the Indian Ocean to Singapore in the Straits Settlements and to Mombasa in East Africa.

An accumulation of evidence awaits the inquiring engineer to convince him that the Diesel-type engine is in reality the sound, practical, serviceable piece of machinery which power-house conditions require. The economy of the type is world-famous; to-day little need be said of that—so much is known. The great need is for the spread of knowledge relating to the many notable performances of the engine, and the few that have been cited above as coming under the notice of one individual will serve to show what a wealth of achievement the engine must have to its credit in the aggregate.

Regeneration by Traction-Type Elevators with Descending Loads

Electric elevators of the "traction" type "pump back" on descending overbalanced loads, sometimes regenerating and feeding into the supply system currents as much as 50 per cent of the full-load operating current, according to a speaker at the recent convention of electrical inspectors at Minneapolis. In the case of a bank of such elevators the effect of this regeneration is often to reduce the effective energy consumption of the group. In laying out the sizes of mains to supply such a bank of elevators the total current-carrying capacity is taken at 80 per cent of the sum of the starting currents. According to another speaker, the maximum demand of a bank of eight or ten elevators will not average much above 25 per cent of the sum of the individual currents.

The traction type of elevator takes its name from the fact that the cable merely passes over the motor sheave, which is at the top of the shaft, the power being transmitted by the friction of the cable on the drum.

PRIME MOVERS IN AMERICAN PLANTS

Steam Turbines Develop More Power than Reciprocating Engines and Dominate Central-Station Field

BY A. A. POTTER[1] AND W. A. BUCK[2]

Tables I, II and III, compiled from United States government publications, show very interesting facts regarding the importance of the various forms of prime movers in the power plants of this country.

In the manufacturing power plants in 1909 steam

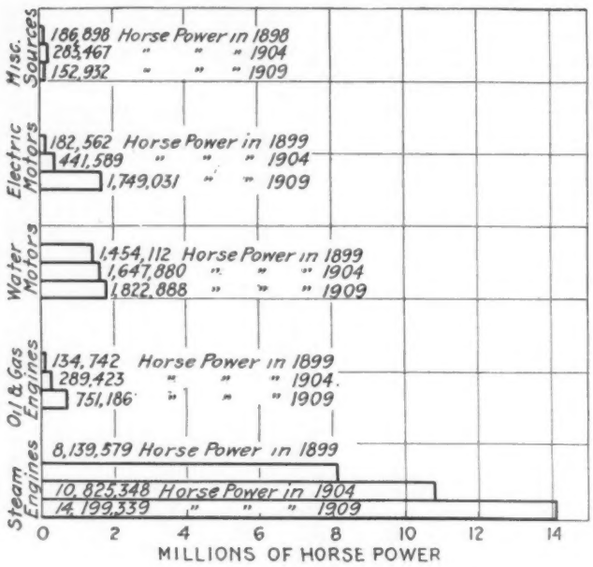


FIG. 1—CHART OF THE POWER USED FOR MANUFACTURES IN UNITED STATES

prime movers developed 76 per cent of the total horse-power. The steam prime movers also developed 72.6 per cent of the total in electric generating stations, which include central stations and electric-railway stations.

Internal-combustion engines developed about 4 per cent of the total horse-power used in manufacturing and 1.2 per cent of the total in electric generating stations.

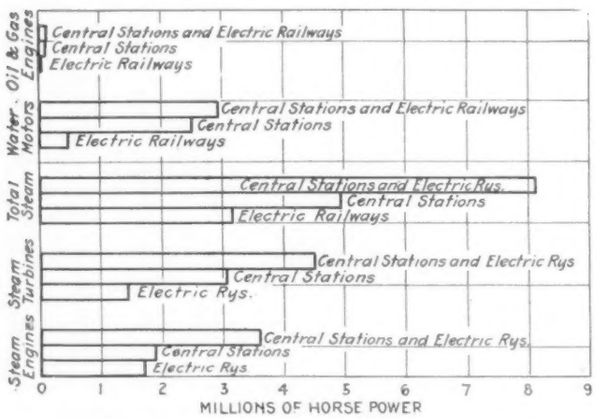


FIG. 2—DISTRIBUTION OF POWER IN ELECTRIC GENERATING STATIONS IN UNITED STATES

Water motors and water turbines developed 9.8 per cent of the total horse-power in manufacturing and 26.2 per cent of that generated by electric stations.

Of the total horse-power developed in electric generating stations by steam prime movers, steam turbines developed 55.6 per cent, while reciprocating engines developed only 44.4 per cent.

In the case of central electric stations, steam turbines developed 3,054,456 hp and steam engines only 1,892,076 hp, or in the ratio of 61.6 per cent for turbines, as against only 38.4 per cent of the total energy generated

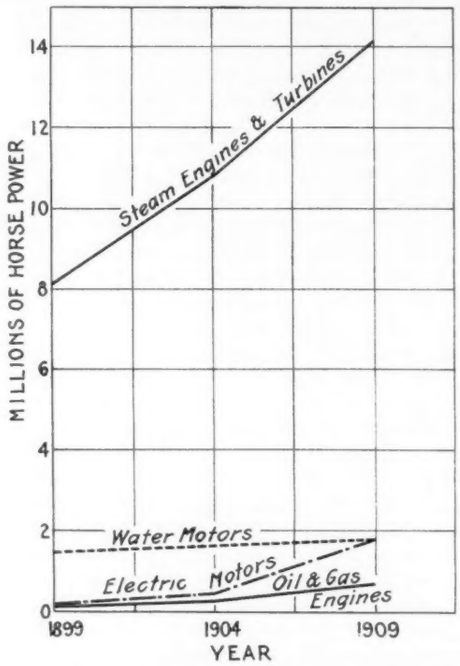


FIG. 3—ELECTRICAL ENERGY USED FOR MANUFACTURES IN UNITED STATES

by steam prime movers for reciprocating steam engines.

The relative importance of the various forms of prime movers in the generation of electrical energy is illustrated in Figs. 1, 2 and 3.

Table III and Fig. 4 show the relation between the types and average sizes of the various prime movers used in manufacturing. The growth in size during the decade from 1899 to 1909 is most marked in the case of gas and oil engines.

Analyzing the growth of prime movers in Fig. 3, it is evident that the use of water motors increased little

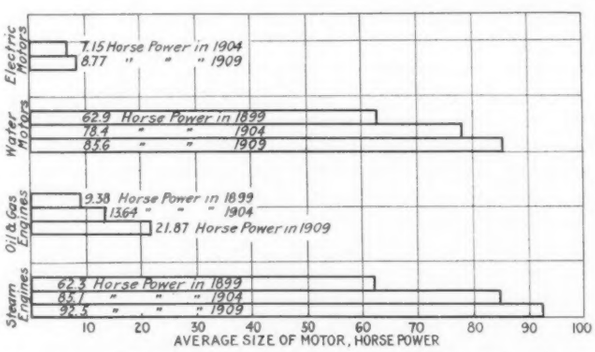

Electric Motors
7.15 Horse Power in 1904
8.77 " " " 1909
Water Motors
62.9 Horse Power in 1899
78.4 " " 1904
83.6 " " 1909
Oil & Gas Engines
9.38 Horse Power in 1899
13.64 " " " 1904
21.87 Horse Power in 1909
Steam Engines
62.3 Horse Power in 1899
85.1 " " " 1904
92.3 " " " 1909
10 20 30 40 50 60 70 80 90 100
AVERAGE SIZE OF MOTOR, HORSE POWER

FIG. 4—AVERAGE RATING OF MOTORS USED FOR MANUFACTURING IN UNITED STATES

during the decade from 1899 to 1909. In the case of electric motors, of oil engines and of steam prime movers, the rate of growth was much greater during the five years from 1904 to 1909 than during the five years from 1899 to 1904.

The figures of the United States Census Bureau show that the total increase in primary power for manufac-

[1]Dean of the division of engineering and professor of steam and gas engineering, Kansas State Agricultural College.
[2]Fellow in steam and gas engineering, Kansas State Agricultural College.

turing during the forty years from 1869 to 1909 amounted to 16,329,234 hp, steam prime movers contributing 79.5 per cent, water motors 4.2 per cent, in-

TABLE I—POWER USED FOR MANUFACTURES IN THE UNITED STATES
(Source—Bureau of Census, Department of Commerce)

Type of Motor	Horse-Power Used			Per Cent Distribution of Horse-Power		
	1899	1904	1909	1899	1904	1909
Steam engines	8,139,579	10,825,348	14,199,339	80.6	80.3	76.0
Gas and oil engines	134,742	289,423	751,186	1.3	2.1	4.0
Water motors	1,454,112	1,647,880	1,822,888	14.4	12.2	9.8
Electric motors	182,562	441,589	1,749,031	1.8	3.3	9.4
Miscellaneous	186,898	283,467	152,932	1.9	2.1	0.8

ternal-combustion engines 4.6 per cent, and rented electric motors 10.7 per cent. The amount of horse-power generated by steam prime movers in 1909 was twelve times the amount in 1869.

Water-power represented in the 1869 census 48.2 per

TABLE II—DISTRIBUTION OF POWER AND ENERGY IN ELECTRIC GENERATING STATIONS, 1912

	Central Stations	Electric Railways	Total
Total horse-power	7,528,648	3,665,051	11,193,699
Steam engines—hp	1,892,076	1,706,754	3,598,830
Steam turbines—hp	3,054,456	1,462,800	4,517,256
Steam engines and turbines—hp	4,946,532	3,169,554	8,116,086
Water motors—hp	2,471,081	471,307	2,942,388
Gas and oil engines—hp	111,035	24,190	135,225
Rating of dynamos—kw	5,134,689	2,508,006	7,642,755
Kilowatt-hour output	11,532,963,006	6,052,699,008	17,585,662,014

cent and only 9.8 per cent of the total primary power in 1909.

In the ten years from 1899 to 1909 the use of electricity for manufacturing had increased tenfold.

TABLE III—ANALYSIS OF MOTOR SERVICE IN MANUFACTURES IN THE UNITED STATES

Type of Motor	Year	Number of Motors or Engines	Horse-Power	Horse-Power per Motor or Engine
Steam engines	1899	130,710	8,139,579	62.30
	1904	127,267	10,825,398	85.10
	1909	153,525	14,199,339	92.50
Gas and oil engines	1899	14,334	134,742	9.38
	1904	21,215	289,423	13.64
	1909	34,356	751,186	21.87
Water motors	1899	23,099	1,454,112	62.90
	1904	20,992	1,647,880	78.40
	1909	21,282	1,882,888	85.60
Electric motors	1899	.....	182,562	7.15
	1904	61,589	441,589	8.77
	1909	199,309	1,749,031	.....
Miscellaneous	1899	.....	186,898	.....
	1904	.....	283,467	.....
	1909	.....	152,932	.....

Table II shows that the output of electric railways in 1912 was 6,052,699,008 kw-hr., as compared with 11,532,963,006 kw-hr. for central stations. This means that at least 34.3 per cent of the total horse-power generated in the electric stations of the United States was utilized for the propulsion of electric cars, no account being taken of the additional amount of energy sold by central stations to railway companies.

HIGH-VOLTAGE WATER RHEOSTAT

Great Resistance Obtained by Using Thin Stream of Water in Long Y-Connected Boxes

BY L. I. CLARK

Some time ago the writer, under the direction of Mr. Walter G. Clark, as consulting engineer, had occasion to make an efficiency test on a steam electric plant under conditions that were somewhat out of the ordinary. The plant consisted of two 1000-kw, three-phase, 2200-volt alternators with two banks of transformers for stepping up the potential to 19,100 volts. It was desirable to include the entire station equipment, boilers, engine, generator and transformers, of one entire unit in the test. It was necessary, therefore, to place the load on the high-tension side of the transformers, or at 19,100 volts. After numerous interesting experiments, load was secured by means of a water rheostat. The water available was limited in quantity. The supply consisted of condenser water, which originally came from an artesian well and from conservation of rain water. This water was collected in a cooling pond from which it was circulated through the condensers.

The water in the pond had a resistance of approximately 100 ohms per inch cube. The artesian well

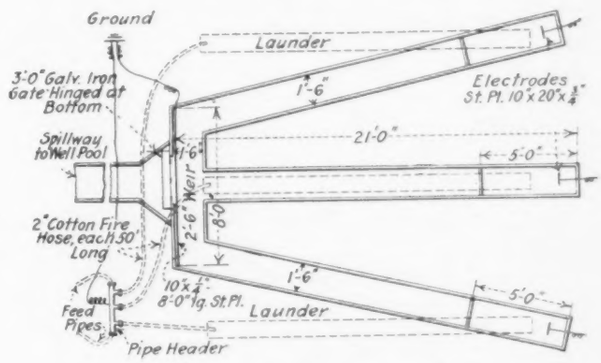


FIG. 1—PLAN OF WATER RHEOSTAT

supplied little more than enough water for boiler feed. This had a resistance of 200 ohms per inch cube. The low resistance (100 to 200 ohms per inch cube) as compared with approximately 1000 ohms per inch cube for fresh water was due to the large amount of minerals, principally soda, which was present. The low resistance, together with the limited quantity available, is the feature controlling the design of a rheostat.

The cooling pond covered about three acres and had a maximum depth of about 16 ft. An attempt was made to secure a load by placing electrodes at the points of an equilateral triangle suspended in the cooling pond. This plan was abandoned when it was found that the maximum spacing resulted in practically a short-circuit. A very satisfactory load was obtained on a rheostat constructed according to the accompanying sketches.

Description of Rheostat

The rheostat was designed for operation with the artesian-well water. As it came from the well this water was collected in a pool having a capacity of about 10,000 gal. and constructed with its top level with the ground. From this pool it was pumped to a tank of about the same capacity placed on the roof of the station. From this tank was obtained the water for the plant.

To supply the rheostat with water two 2-in. lines were used to connect the plant water system to a header having three outlets, each of which was provided with a valve. A separate outlet was used for feeding water to

each leg of the rheostat. The water was conducted to each leg through 50 ft. of cotton fire hose and 20 ft. of open flume. It was allowed to cascade from the hose into the open flume, which was set with a very steep incline, then allowed to cascade again from the flume into the box constituting the rheostat. The hose and flume were well insulated from the ground. As will be noted

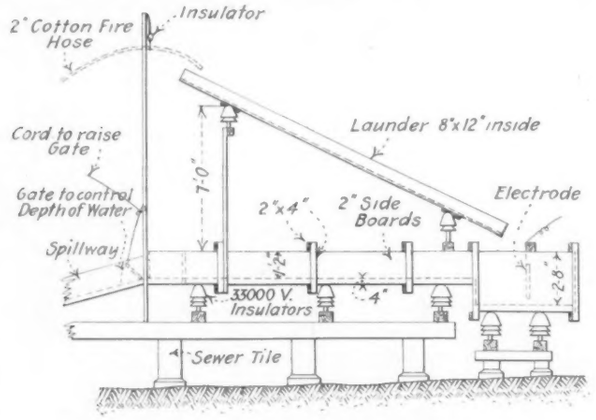


FIG. 2—SIDE ELEVATION OF WATER RHEOSTAT

by referring to Fig. 1, the feeder system forms a Y-connection with the header acting as a grounded neutral. In this feeder system the cross-section of water was made as small and the length of the path as long as possible, in order to introduce a high resistance. The calculated resistance in this water-feeder system was approximately 8000 ohms per phase.

The rheostat consisted of three open boxes, about 21 ft. long and 18 in. square, Y-connected. These were separated at the points of the Y by about 5 ft. and came together in a common box which formed the neutral of the Y. In this neutral was placed a heavy steel plate which was permanently grounded. The whole rheostat was carried on 33,000-volt pin-type insulators.

Feed water was introduced at the electrodes and circulated through each leg of the rheostat from electrode to neutral. A deep weir was cut at the neutral and a gate was inserted hinged at the bottom and arranged to open outward, the pressure of the water tending to open the gate. After passing over this gate the water was collected in a spillway and carried back to the well pool, from which it was again pumped into the piping system of the plant. This formed a complete circuit for the water, and none was lost save that due to evaporation.

The rheostat was constructed with an extra depth at the electrodes, as shown by Fig. 2, for the purpose of allowing for the use of greater surface area of electrode and to provide for balancing the load by changing the position of the electrode with regard to the neutral. It was found necessary to build the rheostat of a comparatively heavy and good grade of lumber, as it had to be water-tight and as the boiling water tended to warp and twist the boxes, causing them to leak. The boxes were, therefore, heavily strapped and cross-tied, as shown in Fig. 2. A cord attached to the gate was carried through the window of the power house to the table inside, where the meters for measuring the load were installed. The load was regulated by varying the height of the gate, thus varying the cross-section of the water in the rheostat.

Keeping the Density of Water Constant

The resistance of the water decreased very rapidly with evaporation. To maintain a uniform density the supply system was thrown wide open when the test was started. In this way evaporation was reduced to a minimum and the density of the water in the rheostat was held constant. It was found unnecessary to shift the electrodes in order to balance the load, as this was accomplished by varying the density of the water in the different legs of the rheostat by adjusting the supply of feed water admitted to that leg. This was done by adjusting the valves at the grounded neutral in the feed-water system after the power had been switched on.

During this test excellent control was obtained on loads ranging from 500 kw to 1200 kw, and it is believed that the load and control could have been secured for a load varying from 250 kw to 2500 kw with the same apparatus.

An interesting feature in connection with the control of the load developed during the test. Before the test was completed the supply of artesian-well water showed signs of becoming exhausted. It was found necessary to introduce water from the cooling pond. This water, as above stated, had a resistance of only about one-half that of the well water. However, when introduced into the rheostat the load was readily held constant by emptying a part of the water from the rheostat, thus reducing the cross-section of the water in the boxes.

There is little doubt that this form of rheostat could be varied to take care of almost any desired voltage and a very wide range of load.

By having both the supply and the outflow controlled at a grounded neutral, it is unnecessary to handle any high potential during the run. With the resistance of the water, the voltage and required load known, it is an easy matter to determine the required length and cross-section of the water. It is important to insulate the circuits well from the ground and to allow enough margin in designing the boxes to prevent boiling over and causing a "ground" in this manner.

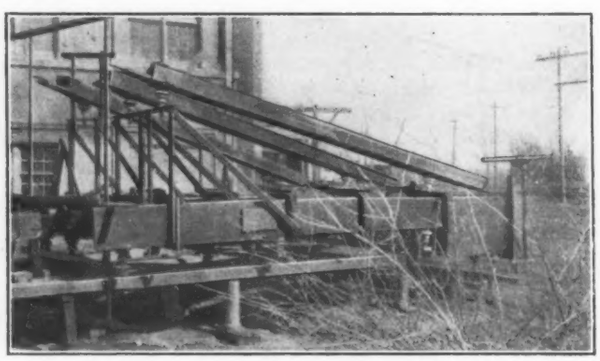


FIG. 3—SIDE VIEW OF RHEOSTAT

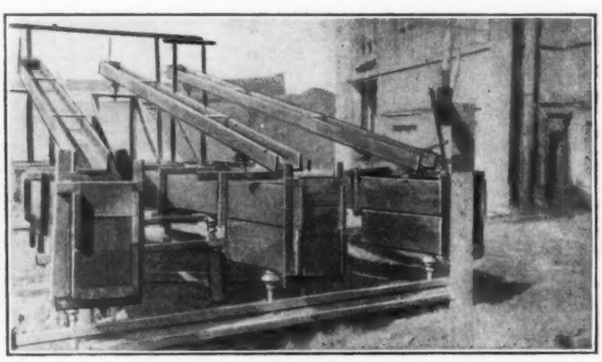


FIG. 4—END VIEW OF RHEOSTAT

Electrically Operated Brick Factory

Application of Motors for Every Operation Involved in Digging Clay, Making and Handling Brick at Springfield, Ill.

IN communities where the nature of the subsoil favors brick-making central-station companies have not been slow to grasp the opportunity of installing motor drive in the brick factories. But there are few installations where the electrification has been carried out so completely as has been done at the

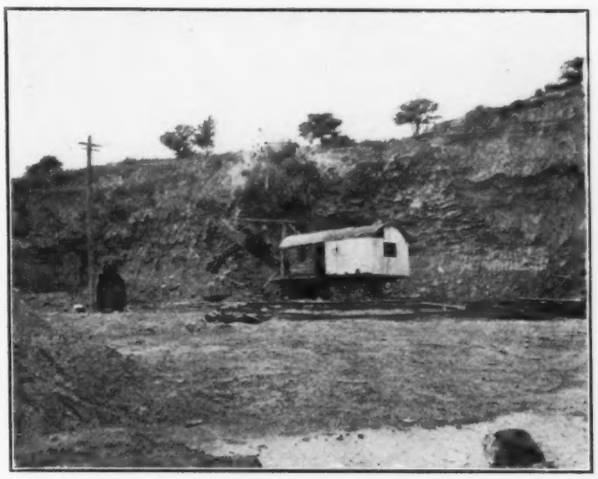


FIG. 1—BLASTING TOP SOIL FROM CLAY CLIFF

plant of the Springfield (Ill.) Paving Brick Company. Here electrical operation begins with the digging of the clay, and every operation, including hauling the shale, dumping the cars, grinding, conveying, mixing, forming the brick and conveying the finished product, is accomplished electrically. Even after the bricks have been stowed away in dry kilns electrical operation does not cease, for the coal burned in the kilns is hauled from an

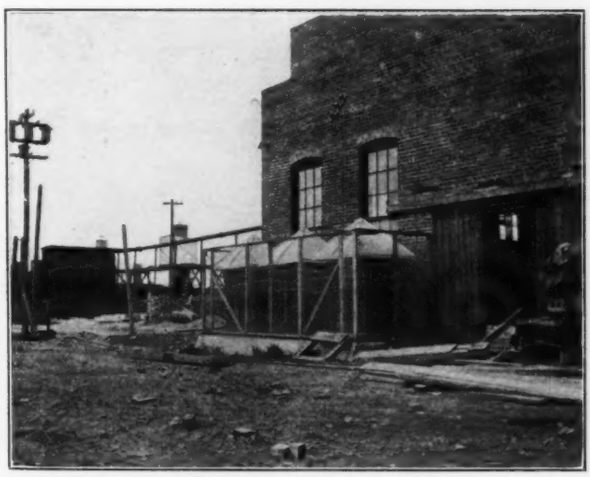


FIG. 2—TRANSFORMER AT SERVICE ENTRANCE

electrically operated mine over a narrow-gage motor-driven tramway. A list of the motors, together with their ratings and the machines they are driving, is given in the table herewith. All motors except those used in hauling finished brick are of the three-phase, sixty-cycle, 440-volt type.

One of the most unusual instances of motor drive found in this installation is that of an old steam shovel which has been electrified. The boiler and engine have been removed, and in their places have been substituted two motors, a contactor panel, and the necessary resistors. One man controls both of the motors by means of a master controller and friction clutches, and the trip on the shovel scoop is operated by an extra man. However, it is planned to do away with this extra helper by installing an electromagnetic trip to be manipulated by a foot pedal within reach of the shovel operator.

The control of the shovel is unique in that notched-back relays are utilized on the panelboard to increase or decrease automatically the resistance of the motor circuit as the shovel load demands. Both the motor on the shovel boom and the one inside the housing are shown in the accompanying illustrations.

Another innovation utilized to secure variable speed is a fan which draws hot air from a tunnel beneath the kilns and delivers it to a drying room. In this apparatus by shifting a clutch a different motor pinion is caused to engage the fan's gear, changing the speed

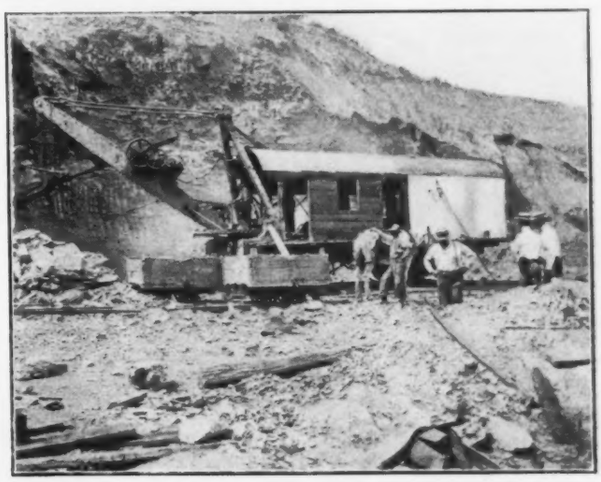


FIG. 3—AN ELECTRIFIED "STEAM SHOVEL"

from 125 to 150 r.p.m. Further variation may be had then, if necessary, by changing the resistance in the motor circuit. Variation in speed is necessary because this fan is sometimes delivering air from a distant kiln and sometimes from one close at hand, and hence operates under changing load conditions.

On the industrial railway operating over the tops of the kilns and supplying coal from a nearby mine one motor, housed at the upper end of the tramway, does all the hauling. In connection with this machine a system of push-button control has been worked out so that an operator riding on a coal car can stop or start it at any kiln. An auxiliary wire suspended overhead also allows the operator to trip the motor switch from any place on the track, but when this emergency is resorted to the operator must walk to the nearest kiln and push a starting button to move the car. At first some trouble occurred on this little industrial railroad, as no provision had been made for taking care of the stretch in the haulage cable, which was continuous and operated around a hoisting drum geared to the driving motor. Now, however, a tension carriage has been added, and

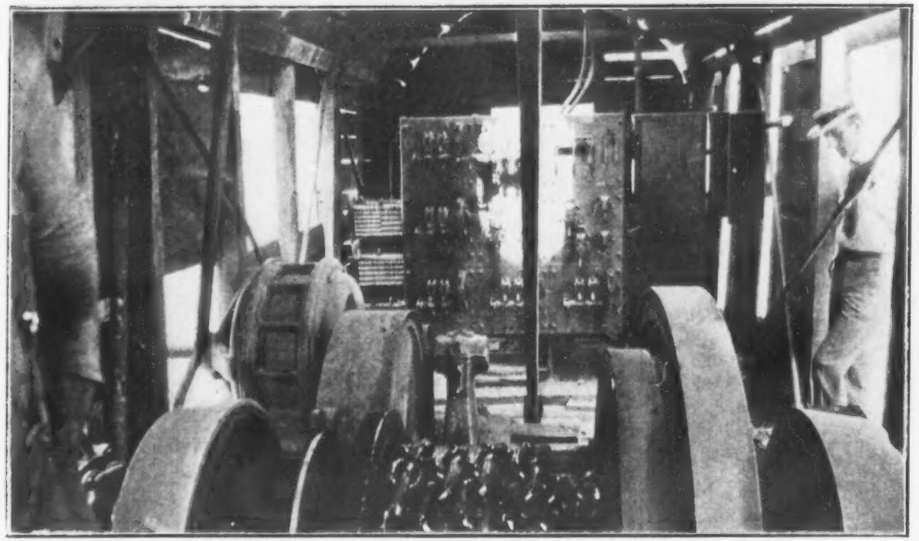


FIG. 4—INTERIOR OF ELECTRIFIED SHOVEL

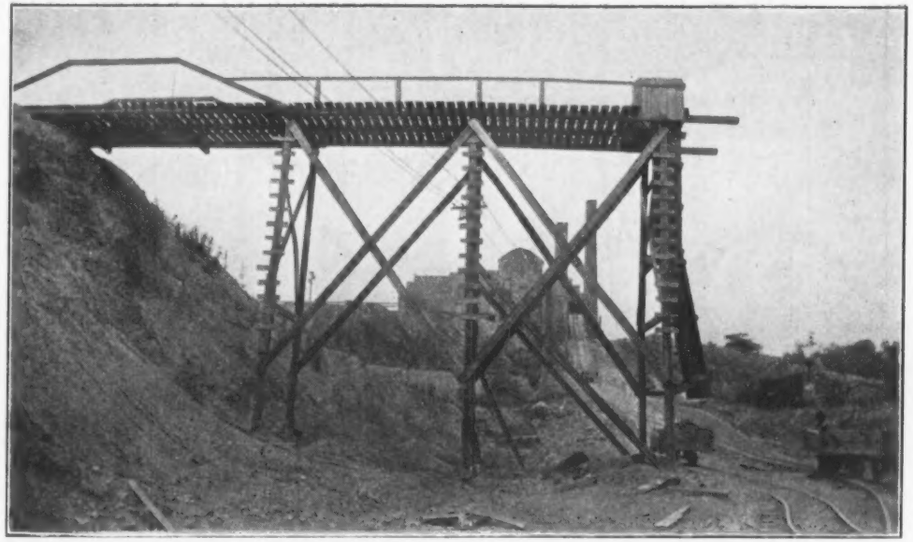


FIG. 6—MOTOR-DRIVEN HAULAGE RAILWAY TO PLANT

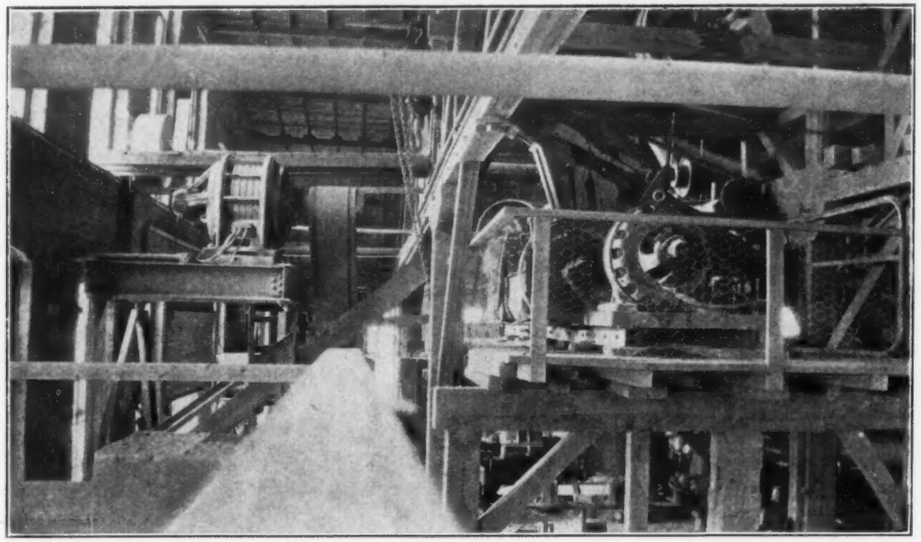


FIG. 5—PLANT MOTORS ON PLATFORMS ABOVE FLOOR

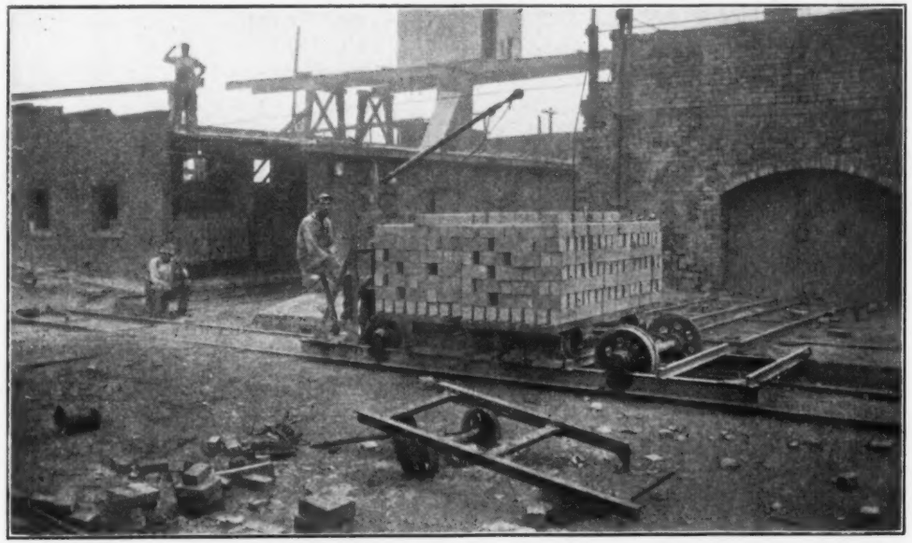


FIG. 7—BRICKS HAULED ELECTRICALLY TO THE KILN

it is arranged so that in case the coal car should leave the track the cable will slip on the hoisting drum and not continue to pull the derailed car along and demolish the trestle structure.

When the plant was formerly operated by steam, record months showed a production of 1,500,000 bricks, but last June more than 2,009,000 were made, and the record for one day, 106,000 bricks shows a peak considerably above the average for the month's production.

During the month of June when the 2,009,000 bricks were made the company's meter showed that it had used 52,860 kw-hr., and hence the energy cost was 26.2 kw-hr. per 1000 bricks, including the energy required for every operation from digging the clay to handling the completed product. On the day when the record of 106,000 bricks was established it was found by checking the meter for that day that the cost had actually dropped to 19.2 kw-hr. per 1000 bricks. However, this figure is below that which is expected as an average, and it is thought that when the maximum output of the plant, 2,500,000 bricks a month, has been attained, the energy used will be about 24 kw-hr. per 1000 bricks.

MOTOR APPLICATIONS IN BRICK MILL

Machine Driven	Rating in Hp	Speed in R.p.m.
Dipper on boom of shovel	37	900
Boom and propeller gears of shovel	52	960
Geared to Lidgerwood shale hoist	35	960
Shale car dumper on friction clutch	3	1700
Two 9-ft. Penfield dry pans	(Two) 75	760
One 8-ft. Peterson dry pan	40	860
Pulverized shale elevator	20	860
Shale drag to pug mill	15	.....
Directly connected to pug mill	50	685
Brick machine	150	720
Conveyor for defective green bricks	5	130
Sirocco 12-ft. fan	40	860
Brick transfer trolley	7.5	800
Motor-generator set supplying direct current for transfer car	12.1–7.5	1700
Forge blower	0.25	.....
Machine-shop line shaft	5	1200
Automatically controls 250-gal.-a-minute fire-service pump	10	1200
Drainage pump at sump in clay pit	7.5	1130
Coal-haul tramway	15	850

Mr. T. J. Armstrong is president and general manager of the Springfield Paving Brick Company, and the energy for operating this installation is supplied by the Springfield Light, Heat & Power Company, of which Mr. A. D. Mackie is general manager. Much of the credit for laying out the installation is due Mr. Roscoe Woltz, commercial engineer for the central-station company.

Electricity Saves Paper Mill $400 a Month

The Carne Paper Company, of Maumee, Ohio, formerly operated its mill with steam from two 100-hp boilers working through reciprocating engines. Recently all but one of these steam engines have been removed and motors have been substituted. Machinery formerly operated through long line shafts is now individually driven, and although the low price of paper has kept the mill idle of late, a seventeen-day run made with the new equipment showed that 302,600 lb. of wrapping paper was produced with an energy consumption amounting to 17,050 kw-hr., or 17.7 lb. of paper per kw-hr. Besides making this record in specific energy consumption, the paper company has been able to reduce the regular force of workmen by two men. It is fully expected that when the mill is again operating at its full rating even better specific energy consumption will be shown, although at the above figure the electrical machinery will save the paper company $400 a month.

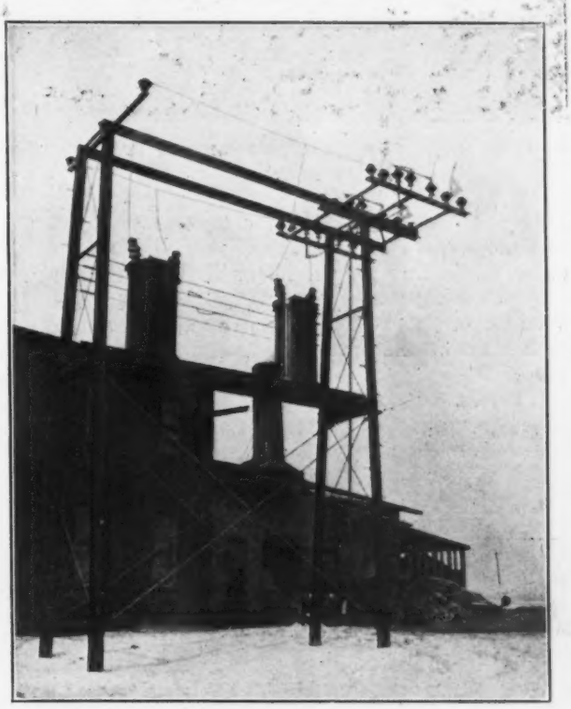
The motors used are all of the 440-volt, three-phase, 750-r.p.m. type, and to operate them energy is supplied from the lines of the Valley Light & Power Company, of Maumee, Ohio, over a 33,000-volt transmission line.

MACHINE EQUIPMENT IN WRAPPING PAPER MILL

Number	Machine Driven	Motor Rating in Hp
2	1200-lb. beaters	35 (each)
1	10-in. stuff pump	
1	6-in. fan	35
1	12-in. plate screen	
1	72-in. wet machine	
1	Pony Jordan refining engine	25
1	Water pump	10
1	72-in. double-cylinder machine	
30	Driers	40*
2	Stacks of calendar	
	Reels and cutters	

*Engine rating.

The transformer station outside the factory, designed to be equipped with three 75-kw transformers, is shown herewith, operating temporarily with open-delta connection. The two old boilers which formerly drove the engines and supplied steam for the "cooking" process are still furnishing steam to drive one engine and to cook the paper stock. The table herewith shows how the machines are grouped.



OUTDOOR SUBSTATION SERVING PAPER COMPANY

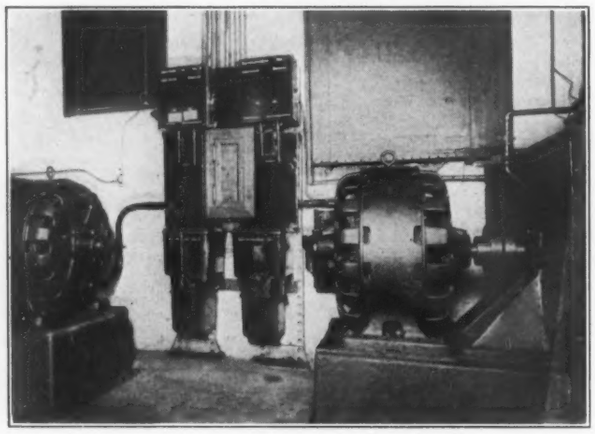
Duplicate Motors with Separate Feeders for Continuous Service

If duplicate motors are employed to maintain continuous service, the assurance of their operation will be doubled if each unit is supplied with energy through distinct and non-adjacent feeders. This practice is employed for generator ventilation at the generating station of the United Electric Light & Power Company, New York City. Each turbine-driven generator is cooled from its individual air duct. Sirocco blowers are installed in the ducts between the intakes and the generators. On both ends of each blower shaft are motors either of which will operate the blower alone. Normally, however, both motors are supplied with energy and

operated at half rating, so that if one unit should accidentally stop the other will carry the entire load. The feeders to duplicate motors are conducted along separate routes so that a fault in one circuit will not affect the other.

Inclosed Externally Operated Service Switches

As these motors, like practically all others in the station, are operated with 440-volt alternating-current



CONTROL EQUIPMENT AND MOTORS DRIVING GENERATOR BLOWERS

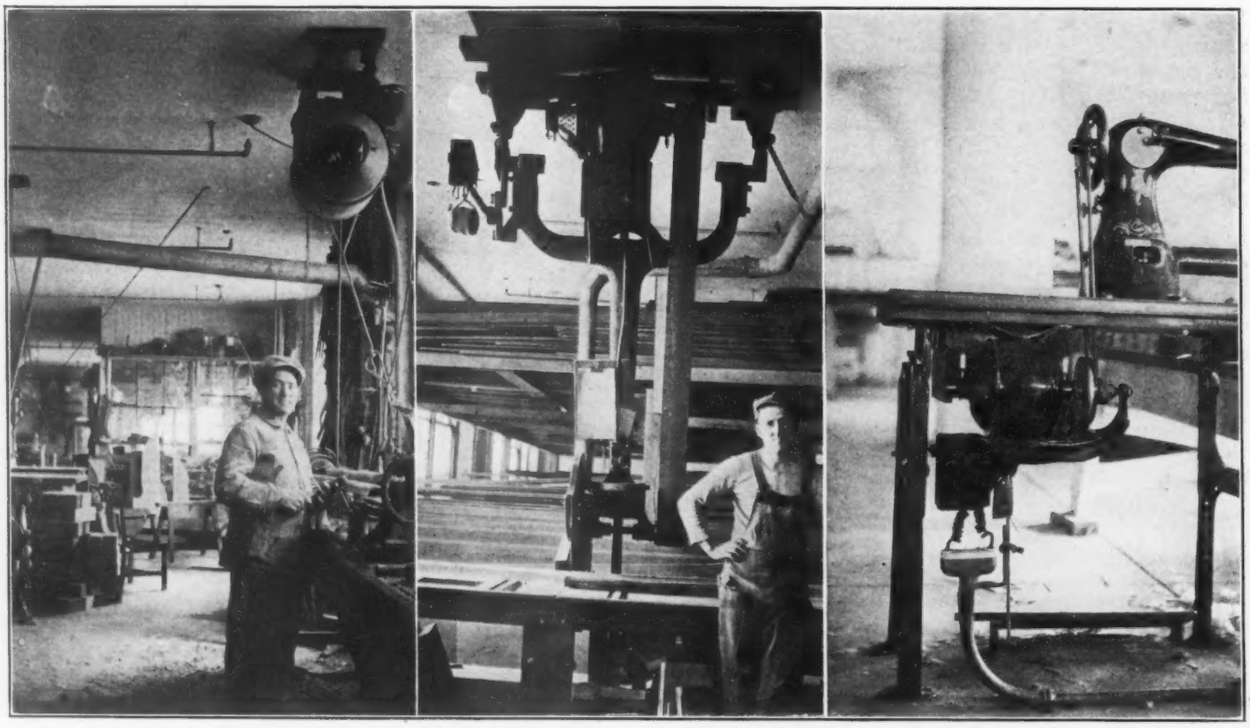
energy, it has been considered best to employ inclosed externally operated indicating service switches. Two sets of these are shown herewith installed above the other motor-control equipment. Each case contains two switches, one for each of the duplicate motors. The handles below the cases are used to open or close the circuits. The fuses which are installed inside the case can be reached only when the circuit is opened and a padlock is unlocked. Further protection is afforded by making it impossible to close the circuits when the cover is open. Indicators above each handle show the position of the switch.

Electrical Service in Large Furniture Store

At the new building of the Paine Furniture Company, Boston, Mass., one of the largest stores of its kind in the world, electricity is extensively used. The service is furnished by the Edison Electric Illuminating Company of Boston through nine feeders of the three-wire, 110-220-volt direct-current type, distribution being effected from a switchboard in the basement throughout the eleven stories of the establishment. There are five Otis electric elevators installed, including one 8000-lb. machine running 150 ft. per minute; two of 4000 lb. rating each, used in passenger service at a speed of 300 ft. per minute, and two combination elevators of 4000 lb. rating each, running 250 ft. per minute. A sixth elevator of 2000 lb. rating connects the first floor and basement only and is used in freight service. Each of the five elevators first mentioned is driven by a 35-hp motor, the smaller unit being operated by a 5-hp motor.

The establishment was laid out to facilitate routing of the merchandise and to afford visitors quick access to all departments, one of the most interesting of which is the cabinet shop of the company on the ninth floor. The company does a large business in manufacturing mattresses, hand-carved and inlaid furniture, and the motor equipment of these portions of its establishment is well adapted to rapid production, so far as machine methods can be used.

Nearly a score of motors are in service in the cabinet shop, all being equipped with push-button control and wired in conduit. The starting boxes are all mounted in a fireproof compartment, 13 ft. 10 in. long, 4 ft. 4 in. wide and 11 ft. high. The rheostats are controlled by contactors as shown in Fig. 4 and are mounted on a wooden frame with 1-in. by 3-in. horizontal members and spaced 22 in. apart on centers vertically. All tools are provided with sawdust-collecting outlets leading into a central duct connecting with a 36-in. fan mounted on the roof and directly driven by a 7.5-hp motor at a speed of 600 r.p.m. The fan exhausts the sawdust from the cabinet shop and delivers it into a horizontal duct passing across the top of the



FIGS. 1, 2 AND 3—MOTOR APPLICATIONS IN FURNITURE FACTORY

building and finally discharging into the boiler room at the basement level. The building is provided with a large vertical conduit and pipe shaft, with grating platforms at every floor to facilitate inspection and repairs.

The motor-driven equipment of the building also includes a 15-hp vacuum cleaner, a 2-hp air compressor used in connection with the sprinkler system, two 4-hp

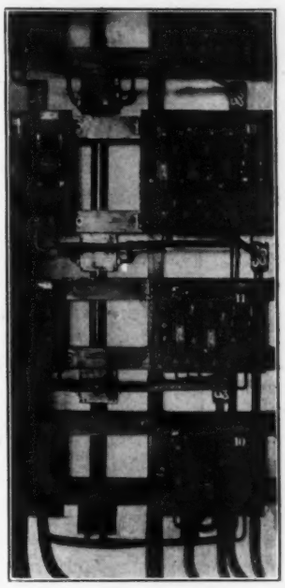


FIG. 4—CONTACTORS FOR RHEOSTATS

sewer ejectors with a 20-ft. lift and 3-in. discharge, a 5.5-hp double rip saw and 2-hp swing saw used in the boxing department, a 2-hp fan exhausting dust from the hair room, a 5-hp hair-picking machine, and several small fans used in toilet-room ventilation and in supplying warm air from the basement to the vestibule of the main entrance. An auto-call system manufactured by the Severance Electric Company, Boston, is in use for the sales force, with signal lamp on each salesman's

MOTORS USED IN FURNITURE ESTABLISHMENT

Motor Hp	R.P.M.	Service
5.5	1675	Buzz planer, Oliver Machinery Company.
5.5	1675	Swing saw, Oliver Machinery Company.
5.5	1675	Circular saw.
9.5	1025	Whitney 24-in. planer.
5.5	1675	Double cross-cut and roughing saw.
2	1900	Grinder, double.
5.5	1675	Vertical spindle saw, double.
1	1275	Jig saw.
5	....	Speed lathe.
3.5	....	Upright boring machine.
3.5	1200	Band saw.
3.5	1825	Horizontal drill, Carey.
3.5	1200	Surfacing machine, Peerless.
5.5	1675	Two 14-in. saws.
2	1900	Horizontal drill.
5.5	1675	Double saw, repairing and finishing department.
1	450	Four Singer sewing machines, direct on shaft.
1	450	Four Singer sewing machines, direct on shaft.
1	450	Two Singer sewing machines, direct on shaft.
1	450	Three Singer sewing machines, direct on shaft.
1	450	Three Singer sewing machines, direct on shaft.
½	2000	One Singer sewing machine in pillow room.

desk controlled from the telephone switchboard on the street floor. Semi-indirect lighting is used throughout the exhibition rooms, four 150-watt lamps per alba bowl being the standard for the first floor and four 60-watt lamps per bowl on other floors.

A list of the principal motors in the cabinet shop and repairing and finishing department is given in the table.

Electric Drive in Building Construction

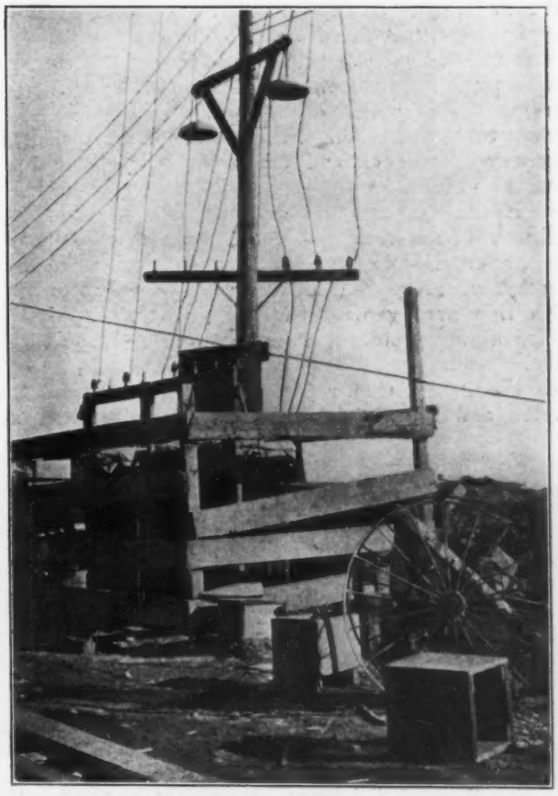
Electric drive in building construction is employed exclusively by the Turner Construction Company of New York in the building of a large spinning mill and storage warehouse for the Naumkeag Steam Cotton Company at Salem, Mass., to replace buildings destroyed last June. Three-phase energy is obtained from the Salem Electric Lighting Company, one of the companies which are operated under the control of C. H. Tenney & Company, Boston.

At a central location on the grounds is a transformer inclosure, 8 ft. by 16 ft., constructed of four courses of 2-in. by 8-in. planks. Inside this are three 75-kw step-down transformers rated at 2200/220 volts. A temporary pole line runs through the works, carrying the cables to a pole erected within the inclosure. The location of motors is such that those of largest rating are, generally, nearest the transformer station.

The Motor Equipment

Motor equipment consists of 10-hp and 15-hp motors on two wood saws, 5-hp to 25-hp motors on four centrifugal pumps, 15-hp motors on two rod-bending machines, a 35-hp motor on a concrete plant for cinders and two 30-hp motors operating a cable gravel tramway with double drum. Two 75-hp motors operate concrete elevators and mixers. In addition, concrete, steel and brick hoists are electrically operated. Each of the layer units is closely housed in a temporary wooden shed.

On each pole of the transmission line are two clusters



TRANSFORMER INSTALLATION AT MILL SITE

of four 40-watt tungsten lamps inclosed in a deep white porcelain concave shade made by Hamlet & Hayes, Peabody, Mass., and known as their four-lamp factory fixture. The operations are being prosecuted by a night and a day shift; hence the need of adequate lighting, which is obtained, the poles being only about 75 ft. apart.

Operating Kinks

Bleeder-Valve Remote Control of Air Pressure

For any given boiler installation and grade of coal there is a definite ratio which should be maintained between the amount of air supplied under the grates

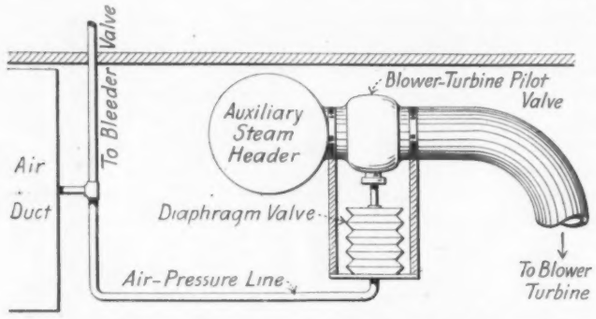


FIG. 1—BLEEDER-VALVE CONTROL FOR BLOWER TURBINES

and the amount of coal fired. If the quality of coal employed is changed, however, it is also necessary to alter the ratio between the air and coal to obtain the most economical results. At the generating station of the United Electric Light & Power Company, New York City, the pressure under the grates is regulated by bleeder valves beside each boiler. The manner in which these valves are connected with the air-supply ducts and the blower-speed control is shown by the accompanying illustration.

The bleeder valve previously referred to is connected with a pipe leading from the air duct to a multiple-diaphragm device which operates the pilot valve of the blower turbine. If the pressure in the duct rises, the diaphragms will expand and operate a lever to reduce the speed of the blowers. The reverse action occurs if the air pressure drops. In case it is found desirable to maintain a different pressure in the duct, the bleeder valve is either opened or closed, as required, thereby changing the turbine pilot valve accordingly. With this arrangement the air pressure can be controlled at any point by running a single pipe to that place.

In the installation referred to a stoker-speed tachometer and an air-pressure gage are installed near

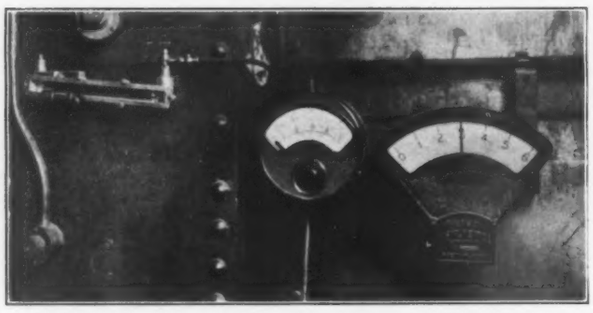
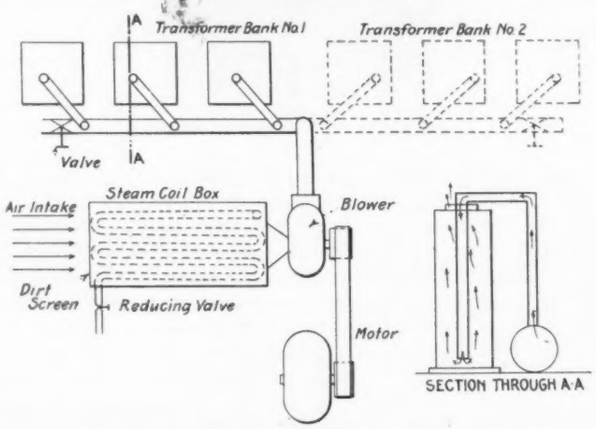


FIG. 2—INSTRUMENTS USED IN OBTAINING ECONOMICAL COAL CONSUMPTION

each bleeder valve, while a draft gage is connected to each boiler uptake. On the tachometer is an auxiliary scale which can be shifted in its position with respect to the regular scale to show the air pressure which should be maintained at any stoker speed. If the air pressure and stoker speed do not agree as indicated by the main and auxiliary scale, the air pressure can be changed by adjusting the bleeder valve. The position of the auxiliary scale is determined by varying the air pressure at full-load stoker speed until the flue-gas analysis shows the highest possible amount of carbon dioxide, without the presence of carbon monoxide, due to insufficient air. Under the condition of the station the flue gas contains from 10 to 13 per cent carbon dioxide, while the carbon monoxide seldom exceeds 0.3 per cent. Only about 1/10 in. suction is maintained over the grates, as a higher value would tend to cause air to be drawn in through the slicing doors and leaks in the boiler settings.

Drying High-Tension Transformers with Steam Heat

Transformers to be used at the terminus of a 33,000-volt line running from the Water Street station of the Toledo (Ohio) Railways & Light Company to the factory of the Willys-Overland Company arrived at their destination during a siege of inclement winter weather. It was deemed advisable, therefore, to dry these units thoroughly before putting oil into the cases. The apparatus used to drive the accumulated moisture from the coils and the laminations of these units was de-



STEAM COILS ARRANGED TO DRY TRANSFORMERS

signed by Mr. A. C. Rogers, the central-station company's steam-heating engineer, and a sketch of the equipment employed is shown herewith.

In all there were nine transformers, six rated at 600 kva each and three rated at 300 kva each. As they stood in the substation all nine units were arranged in a straight line. The drying apparatus was designed to serve a bank of three units simultaneously and to dry six of the nine transformers without being moved from its original position. To heat the air which was to be circulated through the transformers, steam coils with about 300 ft. of radiating surface were disposed throughout a galvanized-iron box, open at one end to admit air through a cloth screen. Steam was supplied to these pipes from a main carrying about 110 lb. pressure, and a reducing valve was interposed between the steam main and the heating coils as a primary method of controlling the temperature of the air delivered. From the coil-box air was drawn through a blower driven by a 5-hp motor and delivered into an 18-in. galvanized-iron header. From the header the hot air was conducted to the bottoms of the transformers through three 4-in. pipes. A valve was also provided at the end of the main air header so that part of the air might be allowed to escape if it became necessary to reduce the temperature of the units. When this apparatus was placed in operation it was expected that a bank of

GRIPPER & SIDE GUIDE

transformers would be thoroughly dried if maintained at a temperature of 80 deg. C. for a period of three days.

Portable Coal Cart for Boiler Room

To facilitate the handling of fuel and to keep the firing aisle floor clean, it is advisable to employ a portable coal car capable of holding about 1000 lb. The car can be run on iron rails or it may have wide-faced wheels

PORTABLE COAL CART

which will run easily over concrete floors. One side of the car should be hinged so that it can be swung down level with the bottom of the car, thus making shoveling easier. Such a car is shown in Technical Paper No. 80, Bureau of Mines, and is reproduced herewith. It is important that the surface from which the coal is shoveled should contain no protruding rivets and bolts or other projections, because these will delay the fireman in filling his shovel. For this reason it is objectionable to have floors made of unevenly laid brick or tile or of concrete which has been allowed to become cracked or uneven.

Synchronizing Twenty-five-Cycle and Sixty-two-and One-Half-Cycle Motor-Generators

At Kansas City, Mo., electrical energy is generated and transmitted to the substations at a frequency of twenty-five cycles in order that the power plant may supply both railway and lighting loads and thus operate

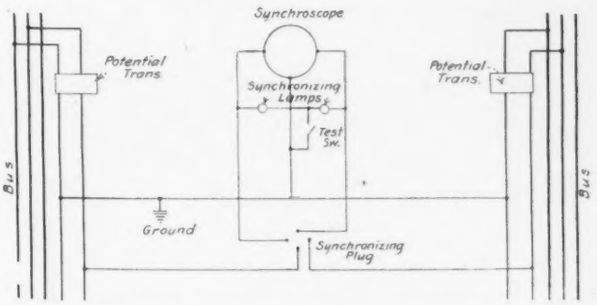


DIAGRAM OF SYNCHRONIZING CONNECTIONS

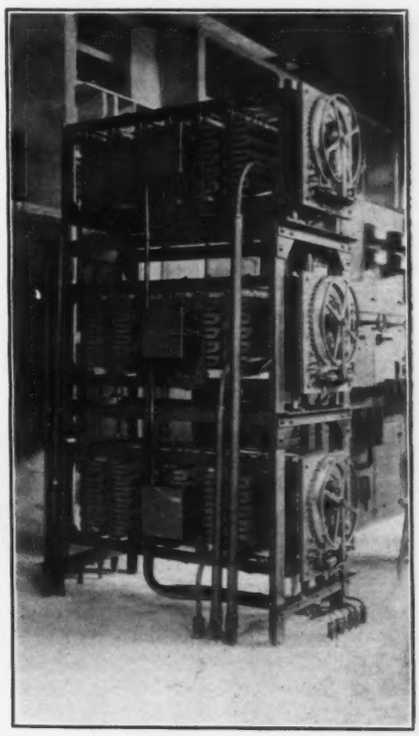
at high power-factor at all times. Motor-generator sets increase the frequency to sixty-two and one-half cycles per second for delivery to the local lighting-service distribution system.

In substations where there are two frequency changers the synchronizing circuits are arranged as shown in the sketch herewith, a scheme which has the advantage of requiring only one synchronizing receptacle, one plug, and one set of wiring for the two machines. The addition of the test switch removes the need for the second synchronizing circuit, for in operation both machines are supplied from the same twenty-five-cycle source of energy, and when started and brought up to speed are, owing to their pole ratios, sure to be in step on the sixty-two-and-one-half-cycle side as well, unless the latter's generator field current needs to be reversed in order to slip a pole.

When the test switch shown is closed, the lamps will flash if the phase relation is incorrect. After reversing the generator field switch, the operator tests again, and unless there is trouble in the apparatus, the lamps and synchroscope will then show the machines to be in synchronism. The wiring scheme shown was devised by Mr. R. K. McMaster, electrical engineer for the Kansas City Electric Light Company.

A Convenient Field-Rheostat Mounting

The mounting of field rheostats is often a troublesome mechanical problem on account of the bulk of the apparatus and the need of ample ventilating space. In an Eastern hydroelectric station the apparatus has been conveniently installed on a structural-steel frame as illustrated herewith, all leads being run in ducts and the frame being in unit sections with open sides and rear ends. The rheostats are of the solenoid-operated type and the contact plates are faced outward parallel to an adjacent switchboard and on a level facilitating inspection and adjustment. In



CONVENIENT FIELD-RHEOSTAT MOUNTING

most hydroelectric stations the available space is sufficient to enable the plant designer to avoid installing rheostats in a crowded position behind or just above the switchboard, provided that the apparatus is of the remotely controlled type. The convenience of the illustrated arrangement compared with the usual installation is marked.

CRIPPEN & SIDE GUIDE

Extracts and Abstracts

Thickness of Fuel Bed for Hand-Fired Furnaces

When burning bituminous coal under boilers the best results are obtained if the fires are kept level and about 4 in. to 10 in. thick, depending upon the character of the coal and the strength of the draft, according to Technical Paper No. 80 of the Bureau of Mines. Coal should be fired in small quantities and at short intervals. Leveling or disturbing the fuel bed in any way should be avoided as much as possible, as it means extra work for the fireman and besides is liable to cause troublesome clinker. Furthermore, while the furnace doors are open, an excess amount of air will enter the combustion chamber, thereby impairing the efficiency. Refuse should not be allowed to accumulate in the ash pit as it may prevent uniform distribution of air under the grate. Whenever coal shows a tendency to clinker it is advisable to keep water in the ash pit. When the draft has to be regulated it should be done by changing the position of the damper and not that of the air-pit doors.

To keep fuel beds level, the coal should be thrown on the thin spots instead of being distributed over the entire grate. In a well-kept fire thin spots can usually be recognized by the bright hot flame given off. Thick places emit a sluggish smoky flame or none at all. Firemen should not attempt to fill up the deep hollows in a fuel bed at one time as the fresh coal may fuse into a hard crust which will offer an obstruction to the air causing the fuel to burn slowly and start new high places. If long intervals are allowed to elapse between firings, thin spots may burn out entirely, allowing a large excess of air to enter the furnace, thereby depriving the boiler of a considerable amount of heat. Another loss is liable to occur when holes occur in the fuel bed, as freshly fired coal may fall through the grate.

If fuel beds are allowed to become covered with high hills and deep valleys, it may be impossible to distinguish the surfaces of thin spots and still more difficult to place coal over them. The quickest way of making such fuel beds level is to break the caked coal forming the heaps and to spread it over the thin spots with a rake. This method should be employed only when absolutely necessary, as it allows excess air to enter through the furnace door and starts the formation of troublesome clinker, besides putting extra work on the firemen.

Proper Position While Firing

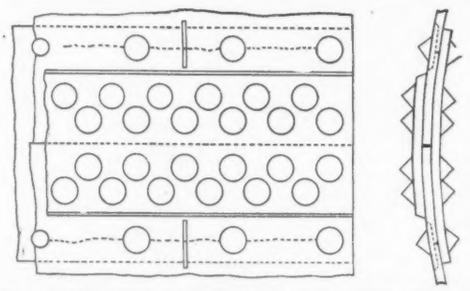
To transfer coal from the coal piles to the furnace to the best advantage the fireman should stand about 4.5 ft. to 5 ft. in front of the furnace door and 12 in. to 18 in. to the left. If the working supply of coal is placed 6 ft. to 7 ft. in front of the furnace, the fireman can fill his shovel and swing it into the furnace with comparatively little effort. The scoop should be suddenly stopped at the entrance to the fire-door frame to avoid the effort of withdrawing it through the door. If the coal pile is placed closer than 7 ft. from the furnace, the fireman will not have enough room to swing his shovel properly, and besides must stand too close to the furnace, thereby exposing himself to the intense heat radiated by the fire. When working in cramped quarters firemen will generally stand to one side of the furnace door to avoid the heat, making it necessary to swing the scoop along the arc of a circle and thereby increasing the chance of scattering coal on the firing floor or in the ash pit. Working under such conditions it is also difficult to deliver the coal to the proper part of the grate. Another objection to having a cramped firing aisle is that it hinders the handling of fire-cleaning tools.

Importance of Supervision of Repairs

Recently an operating engineer experienced considerable trouble from water being carried over into the engine cylinders and, being unable to ascertain the cause, solicited outside assistance. On visiting the plant, the inspector observed that the engine cylinders would probably have been wrecked had it not been for the faithful service performed by the relief valves. Finding that no previous trouble had been experienced from foaming or priming prior to a change in the feed-water piping, he proceeded to examine the latter and found conditions existing which could have been prevented had the repairs been thoroughly supervised. According to the January bulletin of the Hartford Steam Boiler Inspection & Insurance Company, the repairmen in attempting to attach the feed-water pipes firmly to the braces inside the boilers had left an elbow on the outlet of the pipe which terminated close to the steam-header connection. As a result, when the boiler was delivering steam and the feed-water pipe discharging water into the steam space, large quantities of water were carried along with the steam into the engine cylinders. The trouble was corrected by changing the position of the feed-water pipe outlet.

A New Method of Inspecting Boilers

Probably no boiler defect evades detection more than the hidden crack which forms under the overlap of a joint. Such cracks form with alarming frequency in lap-seam boilers which have been in operation for some time. Sometimes these cracks may be revealed by applying a hydrostatic pressure to the suspected boiler and hammering the seams. A much better method of detecting seam cracks, however, has been devised by Mr. S. F. Jeter, supervising inspector of the Hartford Steam Boiler Inspection & Insurance Company. His process consists in cutting narrow grooves or slots nearly through the plate joint and at right angles to the probable course of the crack, so that cracks which may develop will be visible at the bottom of the slot or will start a warning leak before the structure has been weakened to the explosion stage. V-shaped notches may be cut in the calking edge of overlapping plates to uncover the region in the underlying plate which is subject to crack formation. Such notches will not weaken a joint appreciably if they are not closer than 1 ft. apart along the longitudinal seams. Similarly to detect fractured stay bolts telltale holes may be drilled in the ends of the bolts as far as the inside stay sheet. Butt-strapped

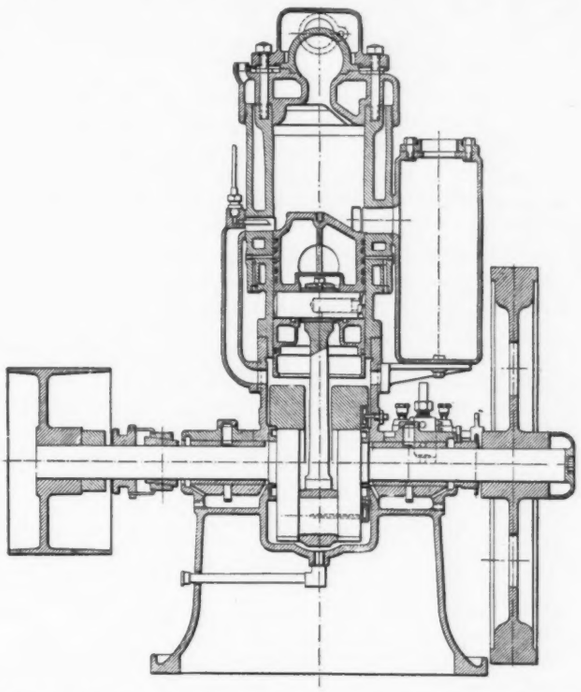


METHOD APPLIED TO A BUTT JOINT OF THE WIDE INNER-STRAP TYPE

boilers may also develop hidden cracks if the plates do not conform with the arc of the boiler drum. When the outer strap is narrower than the inner one, it is only necessary to make a groove in the sandwiched plate to furnish a telltale. When both straps are the same width, however, it is necessary to make a V-shaped notch in the outer strap before a groove is cut in the intermediate plate.

Two-Stroke-Cycle Semi-Diesel Engines

According to *Engineering* of London, the economy of two-stroke-cycle semi-Diesel engines is being increased, and other advantages, such as ease of starting, reliability, etc., are making them exceedingly attractive. At the Royal Agricultural Show and at the Smithfield Club Show not long ago in England was exhibited a two-stroke-cycle engine embodying several interesting features. Like most two-stroke-cycle machines the engine compresses the scavenging gas in the crank case, the degree of compression being regulated by a flap valve. The cylinder head fits over the jacket walls, the joint between the head and the cylinder walls being closed by means of a rubber gasket. This construction permits unequal expansions of the cylinder and jacket. The hot bulb is not bolted down but is held in place by a ring cover which presses evenly all around the flange. Another interesting feature of construction is that the scavenging and exhaust ports are placed in line with the crank shaft so that the lateral thrust of the piston head will be against an unbroken cylinder wall. The piston head contains an insulating air chamber which protects the gudgeon pin from heat, keeps the temperature in the crank case low, and improves operation in general by facilitating lubrication.



CROSS-SECTION OF TWO-STROKE-CYCLE SEMI-DIESEL ENGINE

The engine is regulated and governed by varying the stroke of the fuel pump, which is driven by a cam on the main shaft of the engine. Force-feed lubrication is provided for the cylinder, gudgeon and the crank pin. The cylinder oil is supplied through two small ports overrun by the piston rings at the bottom of the stroke. The bearings are ring-oiled. Water is circulated through the cooling jackets by a chain-driven pump connected with a free-wheel sprocket which is unaffected by pre-ignition. The hot bulb is initially heated by a blow torch, about three minutes being required to start on crude oil and five minutes on paraffin. The engine shown in accompanying cross section is capable of developing 9 brake-hp at 475 r.p.m. The cylinder measures 7 in. in diameter by 8 in. long. The Messrs. Martin's Cultivator Company, Ltd., is the manufacturer of this engine.

Questions and Answers

Removing Grease Strains from Concrete

Please tell me how to remove grease and oil spots from the cement floor of an engine room. L. K. T.

Hydrated lime exhibits an affinity for oil and grease and will remove such stains from cement floors.

Brass Tubes in Steam Condensers

Why are the tubes of steam condensers made of brass instead of iron or steel? J. Q. A.

Brass tubes are used because they are less rapidly affected by corrosion than are iron or steel tubes, and therefore need not be renewed so frequently.

Blown Oil or Thickened Oil

What is a blown oil? F. S. O.

It is an oil, such as rapeseed oil or cottonseed oil, that has been treated by being heated and having a current of air forced through it. The result of this process is to thicken the oil by increasing the viscosity and the density. It is also called thickened oil.

Resistance at Brush Contacts

What should be the resistance at brush contacts? E. B. T.

With carbon brushes the average resistance at contacts is about 0.028 ohm per sq. in. The current density, brush pressure and peripheral speed of the commutator affects the resistance, however. At 15 amp per sq. in., the contact resistance may be 0.40 ohm per sq. in., and at 60 amp it may be 0.022 ohm. The average value given above is for ordinary speeds and a pressure of 1.75 lb. per sq. in. By reducing the pressure to 0.75 lb. the resistance may be raised to 0.035 ohm. For copper brushes the resistance is one-tenth of the average values given for carbon brushes.

Autogenous Welding

Please explain what is meant by autogenous welding. J. McD.

In the ordinary sense of the term, welding is the joining of pieces of iron or steel by heat and pressure, accompanied by the use of a flux; but autogenous welding involves the use of high temperature alone, without employing flux, pressure or hammering to unite the pieces. Instead, the ends of the pieces to be welded are brought to the welding temperature by an oxy-hydrogen or an oxy-acetylene flame, and then additional metal is fused by the same flame and is run between the surfaces to be joined. The process thus becomes one of fusion, in which the ends to be united, as well as the metal run in, are brought to the melting point and then allowed to cool, when they solidify into a single piece.

Round and Square Chimneys

Why are chimneys more often made circular in cross-section than square? E. K.

There are several reasons why this is the case. One reason is that, for equal capacities, the round chimney presents a smaller effective surface to the pressure of the wind than does the square chimney; hence the force tending to overturn the round chimney is the smaller, other things being equal. The round chimney can be constructed of a smaller quantity of material than can a square chimney of equal capacity. Again, the round chimney has an advantage over the square chimney in that, for equal capacities, the radiating surface of the round chimney is the smaller. Finally, the resistance to the flow of the gases in the round chimney is less than in the square chimney.

Object of Air Chamber on Pump

Please explain the duty of an air chamber on a pump. F. T. L.

The air chamber on a pump is simply a shock absorber. If it were not used, the sudden setting in motion of a column of water at each discharge stroke would cause shocks to the discharge connections and the pump itself. The air in the chamber acts as an elastic cushion, which is compressed during the early part of the discharge stroke and expands during the latter part. In this way the flow is made more nearly uniform and water hammer is avoided.

Latent Heat of Fusion of Ice

What is the correct value of the latent heat of fusion of ice? A. E. P.

The value commonly used in refrigeration calculations is 144 heat units per lb., but this is apparently a little greater than the exact value. Separate determinations made by a French scientist and by the Bureau of Standards at Washington agreed with remarkable closeness and indicated that the correct value is 143.5 heat units per lb. The value commonly used, 144 heat units per lb., differs from this exact value by a trifle more than one-third of 1 per cent, and may therefore be used in calculations in which no great degree of accuracy is demanded.

Changes in Motor Connections for Reduction in Voltage

We have a 440-volt, three-phase squirrel-cage induction motor with the poles of each phase connected in series. Can the machine be operated on 220 volts? H. F.

By separating the poles of each phase into two groups and reconnecting them in multiple the motor can be operated on 220 volts, at the same rating as before. This can be done by removing one end of the motor housing. Sometimes the taps from the coils connected in series are connected to the motor terminal board, in which case the changes can be made there. It should be remembered, however, that the current per phase will be increased by the reduction in voltage, and hence the feeders, fuses and control apparatus must be made to conform therewith.

Steam Table Based on Absolute Pressures

Why are the pressures in the steam table given in pounds absolute? It would be much easier to use the table if gage pressures were used. V. H. McG.

The values of the boiling point, latent heat, heat of the liquid, etc., given in the steam table must be based on some unchanging value in order that they may be compared accurately. The gage pressure is not an unchanging value. It represents the pressure existing in the boiler above the pressure of the atmosphere. But the pressure of the atmosphere changes according to the weather conditions, and consequently the actual pressure in the boiler varies also, though the hand of the gage may remain at the same point. By using absolute pressures, which are pressures above the zero of perfect vacuum, a basis of comparison is obtained that is unvariable.

Grounding to Water Pipes

Objection has been made by the local board of public works to our grounding the neutrals of our alternating-current secondaries to the city's water mains and pipes. Can you name for me any place where this practice is permitted by the water-works authorities? We have had difficulty in convincing the board that no danger to the pipes attends such grounding. H. M. H.

In many cities the neutrals of alternating-current systems are grounded to the water pipes with the full permission of the local water-works authorities. This practice has, in fact, been approved by the American Water Works Association. Minneapolis, for example, recently gave the local central-station company permission to ground its secondaries to the water-works system, and the company will start work on this grounding as soon as weather conditions permit. The connections to mains will be made by tapping the pipes for half-inch tapered brass plugs, into which the ground wires will be sweated. The work of tapping the mains and inserting the plugs will be done by the water-works department, and the electric company will be charged a fee to cover the cost of the work.

Surface Leakage from Flame-Proof Insulation

Some manufacturers of electrical equipment object to the use of fireproof wire on switchboards and control panels, declaring that it is impossible to secure a covering which combines both insulating and fireproof qualities. Is this correct? F. L. N.

Some concerns manufacturing elevator control apparatus have consistently refused to install so-called "flame-proof" wiring on their equipment on the ground that the surface leakage currents from such wires may involve far greater hazards in the operation of the machinery than inhere in the more remote possibility of fire attacking the cables. In some forms of elevator control panels the relay magnets require only a small current to hold them in position, although they take a much larger current for operation in the first place. It has been found that the leakage currents where fireproof insulation crossed live studs on the board were actually large enough to prevent relays from dropping out when they should, thus seriously interfering with the operation of the elevator. Instances of such trouble occurred recently in connection with the installation of 150 American-built elevators to serve the London underground "tubes," and the cause of the sticking relays was found only after patient search.

Safe Rim Speed of Cast-Iron Flywheel

Use is made of the rule that the rim speed of a flywheel should not be more than a mile a minute. Is this a correct value? C. J. M.

The rule to which you allude is not general, but applies to cast-iron wheels and is only approximately true. Cast iron has a tensile strength of 20,000 lb. per sq. in., but the difficulty of obtaining a sound casting in the case of a heavy rim makes it wise to assume a tensile strength of only 10,000 lb. per sq. in. For the conditions of service to which a flywheel is subjected, a factor of safety of ten seems none too large, and this reduces the safe working stress to 1000 lb. per sq. in. The rotation of the wheel sets up centrifugal forces, acting radially, and if these forces are resolved at right angles to a diameter, the resultant forces will tend to tear the rim into halves by rupturing it at the opposite ends of the diameter. For a rim of cast iron the stress per square inch of rim section due to these forces is $S = 0.0002664\, D^2 N^2$, in which S = stress per square inch of rim section, in pounds; D = mean diameter of rim, in feet; N = number of revolutions per minute of the rim. But the velocity V of the rim, in feet per minute, is equal to πDN, or $DN = V \div \pi$; then, $S = 0.0002664\, V^2 \div \pi^2 = 0.000027\, V^2$. Solving this equation to obtain the rim velocity, $V = \sqrt{S} \div 0.000027 = \sqrt{37{,}037\, S}$. Now, if the safe stress in the rim is taken as 1000 lb. per sq. in., the corresponding speed of the rim must be $V = \sqrt{37{,}037 \times 1000} = 6086$ ft. per minute. This result, 6806, is taken as representing approximately the number of feet in a mile, and thus the rule to which you refer limiting the rim speed of a flywheel to a mile a minute has been derived.

COMMERCIAL SECTION

How the Dayton (Ohio) Company Secured Country-Road Lighting

In Ohio, when a central-station company wishes to contract with an unincorporated community for country-road lighting business it is first necessary for the company to circulate, or to instigate the circulation of, a petition for the lighting. To be presented to the township trustees this petition must bear the signature of persons owning at least 51 per cent of the property along the highway to be lighted. With such a petition in hand the township trustees notify all property owners affected that a hearing will be conducted thirty days from the date of the notice, to give both the dissenters and those in favor of the lighting an opportunity to talk for or against the project. Following the hearing the trustees

COUNTRY-ROAD LIGHTING NEAR DAYTON, OHIO

decide whether or not the lighting is needed and also determine on the number and kind of lamps to be used. Then they advertise for bids on the equipment and work, and thirty days after the advertisements have appeared the contract is awarded.

With the line finished and the energy being supplied, the contractor, which may be the central-station company, presents its bills to the trustees. The trustees then certify to the county auditor the names of the property owners whose real estate adjoins the lighted highway, and the lighting levy money is collected from these people in connection with other taxes, through the county auditor, and is paid to the contractor through the trustees.

After going through this rather extended procedure, the Dayton (Ohio) Power & Light Company has secured country-road lighting business in and near unincorporated districts known as Belmont, Beavertown and Carremonte. The first line is about 2 miles long, the second about 0.5 mile long, and the Carremonte line about 1.75 miles long. Some of the 80-cp incandescent lamps are suspended over the middle of the road from span wires, and others are operated in pole-bracket fixtures. The average spacing is 450 ft. or 500 ft. The people in these semi-rural districts are well satisfied with the street lighting, and one local resident tersely summed up the general feeling of the community by saying that "it took a lot of fussing and red tape to get the lights, but it would take a good deal more to make the people do without them again."

Motion-Picture Film Used to Promote Sale of Tungsten Lamps

The sale of 238 tungsten lamps was recently effected by the Schenectady Illuminating Company, Schenectady, N. Y., through the showing of a film portraying the manufacture of tungsten lamps by the General Electric Company. Arrangements were made to show the film in one of the local theaters, coupons worth 10 cents on the purchase of a tungsten lamp being given with each

SOCKET INSULATING COMPOUND MELTED BY 200-WATT GAS-FILLED LAMP

ticket purchased. Of the 238 coupons returned, 70 were employed in the purchasing of 60-watt lamps, 78 were employed in the purchasing of 40-watt lamps, and the remainder were used in purchasing lamps of other sizes. The relative large proportion of 60-watt lamps sold in this manner was largely due to the fact that the company started a campaign to increase the use of 60-watt lamps in parlors, dining rooms, kitchens, etc., on "Edison Day" and has since made the renewal price of 60-watt lamps less than that of any other size, it being only 15 cents.

Overheating of 200-Watt Nitrogen-Filled Lamp

The lamp and receptacle illustrated herewith were exhibited by Mr. George Cotton at the recent Minneapolis convention of the Western Association of Electrical Inspectors, to show the effect of the high temperature produced by these nitrogen-filled lamps on fusible materials in their vicinity. This 200-watt unit was one of 400 installed in a new factory at Grand Rapids, Mich. After less than ten hours' total operation of the lighting system, the heat from the lamps had melted the filling compound in all the 400 receptacles, and in each case this black mass ran down over the base and bulb. In some instances, according to Mr. Cotton, who is municipal electrical inspector of Grand Rapids, the lamp bases had been actually soldered firmly into their sockets by the melting of the solder on their bases.

Comparative Cost of Flame-Arc and Nitrogen-Filled Incandescent Lighting for Streets

A large Middle West central-station organization has just completed an exhaustive investigation into the comparative costs of street lighting by magnetite-arc lamps and by gas-filled incandescent units, and from this study concludes that while the first costs and overhead charges for the two systems are practically identical, the operating expense of the incandescent lamps (owing to the renewal item) will, under present prices, be about $10 more per lamp per year for the nitrogen-filled lamps than for the arcs.

COMPARATIVE YEARLY OPERATING COST OF ARC AND NITROGEN-FILLED INCANDESCENT LAMPS

	Magnetite Arc	Gas-Filled Incandescent
Trimming, 2.2 hours, at $0.40 per hour	$0.88	.....
Placing renewals, 1.5 hour, at $0.40 per hour	.....	$0.60
Electrodes, twenty, at 5 cents	1.00	.....
Renewals, three, at $4.10 each	.....	12.30
Outer globes, one per year	0.75	0.50
Repairs	0.75	0.40
Rectifier tubes, 2.67 tubes at $20.42 for fifty lamps	1.09	.....
Patrolling, cleaning, inspection, etc	2.00	2.00
Total	$6.47	$15.80
Add 10 per cent	0.65	1.58
Total operating charge	$7.12	$17.38

In preparing the accompanying figures it was assumed that each lamp would be installed with about 1000 ft. of No. 6 wire, representing average lamp spacing in the experience of the company; that the lamps would burn 4000 hours per year, and that energy would be purchased at the plant switchboard at 0.4 cent per kw-hr. The figures compiled relate on the one hand to a 4-amp direct-current magnetite-arc lamp, and on the other to the 600-cp nitrogen-filled incandescent unit having a specific consumption of 0.6 watt per candle and a life of 1350 hours on alternating current.

Central Station Instructs Employees and Dealers in Electrical Merchandising

The appliance department of the United Electric Light & Power Company, New York City, has established a school of electrical merchandising in which it plans to educate its employees, as well as dealers, regarding the proper method of selling electrical appliances. Meetings are held every two weeks on Thursday evenings, from 5.30 to 7.30 o'clock, it being compulsory for members of the appliance department to attend. Arrangements have been made to have representatives of various manufacturers give illustrated lectures on the products of their respective companies, showing articles in the course of construction and then the appliance in actual use to illustrate ideal conditions. It is also intended to show those attending the meetings why appliances are made one way or another and why the manufacturers consider their products the best. The speakers will also outline their selling points and tell what their respective companies are doing to stimulate sales and interest the public in electric appliances.

To reward persons for attending the meetings, and also to indicate how efficiently and conveniently electrical appliances can be employed in cooking meals, light buffet suppers will be served after each session, the food being prepared by the company's regular demonstrators in full view of those attending the lecture. To make the meetings entertaining as well as instructive, it has been planned to show motion pictures illustrating amusing and interesting scenes in which their electrical appliances are used. The films will be supplied by manufacturers and also by the Society for Electrical Development.

At the lectures which have been held so far considerable enthusiasm and interest has been manifested by all present. It is expected that by the end of the schedule of lectures the company will have one of the best educated and enthusiastic bodies of employees to be found among the central stations of the country. Besides this, it will secure the good will of dealers in the vicinity by providing them with live selling arguments. This educational scheme was conceived by Mr. J. V. Guilfoyle, manager of the electric shop.

Discounts for Cash Payment of Contractors' Bills

The plan adopted so generally by utility companies of offering a cash discount for prompt payment of customers' bills has been tried with success by several Minneapolis electrical contractors and has resulted in a great improvement in the promptness with which accounts are settled. To carry out the plan, the rate at which the customer was billed for labor was advanced from 50 cents and 75 cents per hour to 60 cents and 80 cents per hour respectively, and a loading of about 5 per cent was added to all material items. To customers paying within five days from the date of bill a discount of 5 per cent was allowed. In this way customers who caused the contractors the least trouble for collections obtained their work at practically the same price as before, while those who delayed in paying were charged for the extra work imposed upon the contractor's accountants and collectors. Most surprising, however, was the promptness with which customers' checks were received before the individual accounts were allowed to become "cold."

Proof That Electrical Advertising Pays

Mr. Oliver W. Holmes, president of the Snowflake Laundry Company in Toledo, Ohio, not long ago proved to his own satisfaction that electrical advertising is the advertising that catches the public eye. As the story is told, Mr. Holmes, although operating five electric signs already, decided to buy an electric-clock sign as a further advertisement. With the new timepiece installed and in operation above one of the existing roof signs, he wanted to determine whether or not people were reading his signs, and so had one of his men set the clock incorrectly at 5:15 p. m. From that time until 6:20 p. m., or during just one hour and five minutes, his telephone operator answered sixty-four calls from persons who wanted to inform the Snowflake company that its electric clock was wrong.

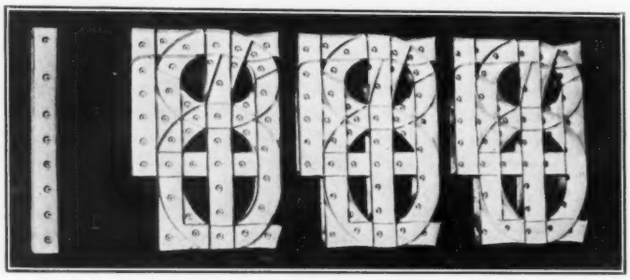


FIG. 1—DETAILS OF TIME MONOGRAMS

In speaking about the test after it had been made, Mr. Holmes told Mr. A. K. Young, new-business manager of

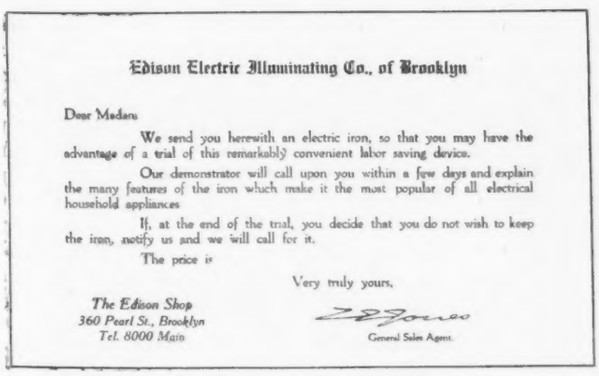
the Toledo Railways & Light Company, that although the clock cost $750 he was convinced he had never spent a like amount of money for any kind of advertising which had shown better returns. Electricity for operating

FIG. 2—CLOCK SIGN THAT PROVED ITS WORTH

the entire equipment of the laundry, as well as for lighting the signs, is purchased from the central-station company. The electric clock was sold by Betts & Betts, New York City.

Two Hundred Irons a Month on Trial

Realizing that electric irons are probably the most-used and consequently the best revenue-producing appliances, the Edison Electric Illuminating Company of Brooklyn is leaving irons with its consumers for thirty days' trial. Several days after the devices are delivered demonstrators call and explain the features, convenience and operating cost of the iron. If at the end of the trial a consumer does not wish to keep the appliance he may notify the company, which will send a representative to call for it. Usually, however, after using the lavor-saving device a consumer prefers to keep it. As the price asked is very low, it is not difficult to collect the amount in full. Even if the irons are returned, they are



Edison Electric Illuminating Co., of Brooklyn

Dear Madam

We send you herewith an electric iron, so that you may have the advantage of a trial of this remarkably convenient labor saving device.

Our demonstrator will call upon you within a few days and explain the many features of the iron which make it the most popular of all electrical household appliances

If, at the end of the trial, you decide that you do not wish to keep the iron, notify us and we will call for it.

The price is

Very truly yours,

The Edison Shop
360 Pearl St., Brooklyn
Tel. 6000 Main

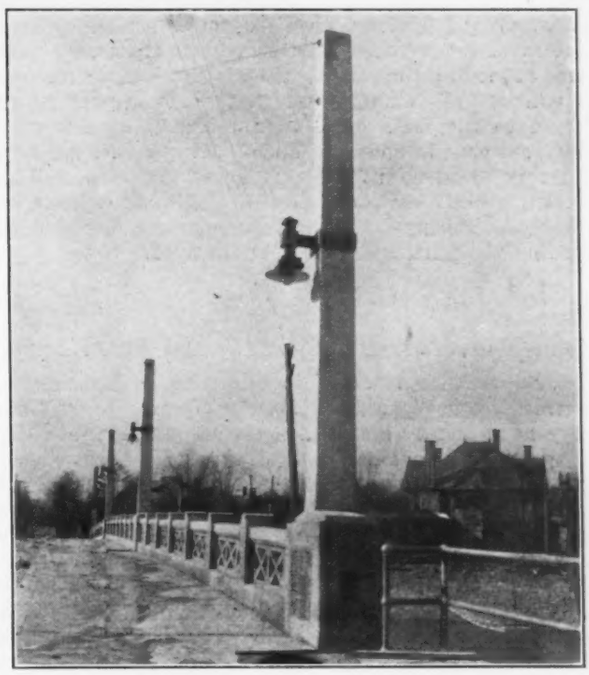
General Sales Agent.

CARD SENT WITH TRIAL IRON

still suitable for distribution, as they cannot be injured by the handling received during trial. The only part which can deteriorate is the heating unit, but the customers are assured of long service by a length-of-service guarantee. The addresses to which the irons are sent are selected from the company's list of connected houses, the appliances being delivered in electric vehicles at the rate of about 200 a month. Along with each iron is sent a card like the one reproduced herewith.

Modern Bridge Lighting at Tiffin, Ohio

When the big flood of March, 1913, swept through the Middle Western States the raging waters of the Sandusky River demolished three bridges at Tiffin, Ohio. Two sightly new concrete structures have been erected on two of the former bridge sites, and on these modern river crossings special attention has been paid to the lighting. As is shown in the accompanying photograph, the fixtures are of heavy bronze designed to harmonize with the sturdy and massive lines of the



MODERN LIGHTING ON NEW CONCRETE BRIDGE AT TIFFIN

bridge. Series gas-filled tungsten lamps rated at 100 cp, hooded with prismatic reflectors, are used in these fixtures.

The Meterman and His Duties

When the customer who has made a complaint is approached by the meterman in a courteous manner, the customer feels that the company is taking an interest in his complaint and hence he will give, in most cases, much more information concerning the use of his equipment than if he were approached in a brusque and inconsiderate manner, said Mr. J. L. Wright, of Toledo, at a conference of metermen of Ohio central stations, held at Zanesville.

True courtesy should be practised and cultivated by metermen in all their dealings with the public, continued Mr. Wright, for this attitude makes friends for the men and for their company.

Courtesy and Efficiency Go Hand in Hand

It will be found, on looking over reports concerning complaint investigations turned in by metermen, declared the speaker, that almost always those that are clearest as to the cause of the complaint and its remedy

are turned in by men who in dealing with the consumer are invariably courteous.

Moreover, the meterman should exercise diplomacy in conversation with the consumer, and care must be taken that he makes no statements that could in any way be misconstrued. The meterman's attitude toward the consumer making a complaint should be one of receptive attention, and the consumer should be made to feel that his statements will receive consideration and that the company will do everything possible to satisfy his complaint.

Beware of Being Misunderstood by the Customer

If any discussion arises between the consumer and the meterman, it should be understood by the latter that in the use of technical terms he is very liable to be misunderstood and misquoted because the average consumer's knowledge of electricity is limited. For this reason explanations in simple language only should, whenever possible, be given to the consumer. Great care must be exercised particularly in answering questions regarding the results of tests and similar matters. It will be very much better that the consumer be referred to the main office than to have the meterman make statements based on unchecked calculations, or in order to avoid admitting that he is not very well informed concerning some part of the work or that another department will have to render the decision regarding the particular question involved.

Home-Made Carrying Case for Gas-Filled Lamps

For the convenience of solicitors in its lighting department, the Worcester (Mass.) Electric Light Company has recently designed a simple and effective carrying case for gas-filled lamp work, as shown in Figs. 1 and 2. In demonstrating the advantages of this equipment in place of cluster gas lamps or in stores or factories where the lighting system is behind the times, the solicitor uses a 300-watt nitrogen-filled lamp with Bryan-Marsh globe and holder. To facilitate service trials on the spot two sections of lamp cord aggregating 50 ft. in length are carried with the lamp, besides extra 6-amp and 10-amp fuses, so that service can be immediately restored in the event of connecting the gas-filled unit to a heavily loaded circuit. The lamp-carrying case is of fiber and is 15 in. high, with a diameter of 8 in. It has a riveted shell 1/64 in. thick and a cover 2.25 in.

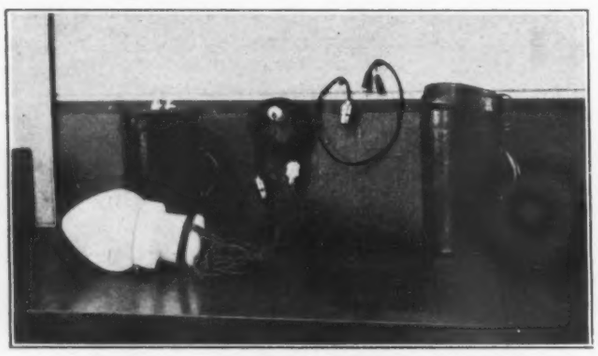


FIG. 1—EQUIPMENT OF CARRYING CASE

deep. On the inside, at a distance of 3.5 in. from the bottom, a felt band 3 in. wide extends around the case where the globe would otherwise come in contact with the shell, and at the bottom the tip of the globe is protected by a felt pad 4.5 in. square, with a 1.25-in. hole in the center which receives the tip. A leather strap 7/8 in. wide and 1/16 in. thick fastens the top, and a stout handle at the side facilitates carrying the case (Fig. 2). The lamp cord, fuses and a short section of adapting circuit equipped with an Edison socket and clips covered with rubber fingers to enable quick and safe connections to be made off the customer's service switch on the outside of the meter are all carried in the bottom of the case. The length of cord carried allows

FIG. 2—CARRYING CASES FOR GAS-FILLED LAMPS

the lamp to be supplied with energy from an adjoining store by a temporary run where the individual receiving the demonstration has no service of an electrical character. The case without the lamp weighs 26 ounces, and the cost of the cases to the company was only about $1.50 each.

Gas-Filled Lamps for Theater and "Movie" Stage Lighting

A new application of the gas-filled high-efficiency tungsten lamp is in the lighting of moving-picture studios where playlets are being enacted before the camera. In the plants of the companies producing the more costly films 1000-watt nitrogen-filled lamps to the number of eighty-six have been used to illuminate a single stage. In the smaller studios fifteen or twenty 1000-watt units suffice for ordinary pictures. The advantage claimed for the high-efficiency incandescent lamp over other illuminants which have been heretofore used is the correction of color values possible with a lamp giving a continuous spectrum. The "make-up" which moving-picture actors have had to use to bring out the features of the face is avoided, and a better balance is given to the flesh tints, it is said.

The introduction of the gas-filled lamp has worked a great saving in some of the Chicago theaters where arc spot-lamps were formerly employed. Since the Iroquois Theater fire a city ordinance has required each arc spot-lamp to be operated by a special attendant. These men were paid $1.50 per performance, but with the incandescent spot-lamps no attendants are needed, and consequently the new equipment pays for itself in a few days.

NEW APPARATUS AND APPLIANCES

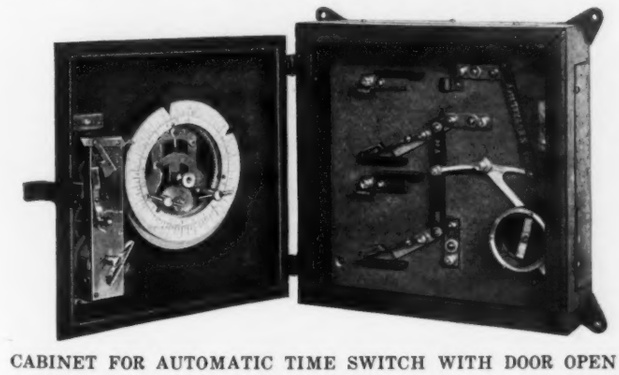
Winch on Truck for Raising Lighting Poles

In the accompanying illustration is shown a truck owned by the Public Lighting Commission of Detroit, Mich., equipped with boom and tackle for setting lighting poles and a winch of the drum type which is operated from the engine shaft of the truck. The winch can also be utilized without the boom and tackle for hauling articles off and on the truck. Winches similar to that used on the truck shown herewith may be equipped with spur gears or worm gears. All gears are cut, are inclosed and run in oil. The drum is machined and is made in various sizes, according to the amount of rope which is to be wrapped around it. The winches are made for single-line service and are built with ratings varying from 1000 lb. to 2000 lb. They are being manufactured by the Northern Engineering Works, Detroit, Mich.

MOTOR TRUCK EQUIPPED WITH WINCH CONNECTED TO ENGINE SHAFT

Automatic Time Switch

An automatic time switch designed to control sign lamps, street lamps, apartment-house hall lamps, show-window lamps, charging of storage batteries, etc., is being made by the Empire Engineering & Supply Company, 227 Fulton Street, New York. The mechanism is inclosed in a cabinet, as shown in the accompanying illustration, and when the door is closed only the face of the clock is visible. The clock is equipped with an eight-day movement and a lever escapement. The switches are flat-mounted and are of the quick-break knife type. They are fitted with carbon contacts to prevent arcing. A twenty-four-hour dial is provided with a number of hands equal to the number of operations required per day. The hands indicate the time of operation and can readily be set and changed about. Conduits can be brought to any side of the cabinet. The device is made in four types, the dimensions of each being 11 in. by 11 in. by 4 in. The first type is designed to be on and off every day as many times as required. The second type is the same as the first type, except that it operates six days, Sunday, or the seventh day, being omitted. The third type is equipped with a double-throw switch for two-rate meter service. The fourth type is provided with two circuits and may be used for hall lamps or special lighting. It operates as follows: (1) all lights on, (2) main lights off—night lamps on, (3) night lamps off.



CABINET FOR AUTOMATIC TIME SWITCH WITH DOOR OPEN

Current Indicator

In the accompanying illustration is shown a device for indicating to the driver of an automobile whether the battery is being charged or discharged or whether the circuit is open. The lettering is horizontal, and to facilitate the reading of the letters the "charge" position is indicated in black, the "discharge" in red, and the "off" in white. The case is the same as that used with automatic switches for automobile-lighting circuits made by the Hartman Electrical Manufacturing Company, Mansfield, Ohio, the maker of the device, and the indicator can be mounted with the switches, a single-face plate being used to cover all instruments.

INDICATOR WITH CURRENT "OFF"

Electric Multi-Stage Centrifugal Pump

The accompanying illustrations show a three-stage electrically operated centrifugal pump which is one of several types of multi-stage machines just placed on the market by the Goulds Manufacturing Company, Seneca Falls, N. Y. The principal feature of this pump, according to the manufacturers, is the lateral discharge through the guide vanes from one stage to the next,

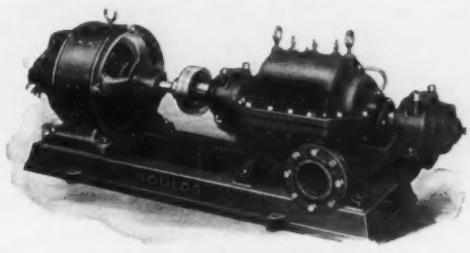


FIG. 1—PUMP DIRECTLY CONNECTED TO MOTOR

which permits the use of a small casing and therefore a comparatively small pump for any given service. The pump casing is horizontally divided and the bearing housings are cast integral with the lower half of the pump casing. Pumps provided with 4-in. and 5-in. discharge and suction pipes are equipped with impellers independently balanced against end thrust and are in addition fitted with ball thrust bearings which run

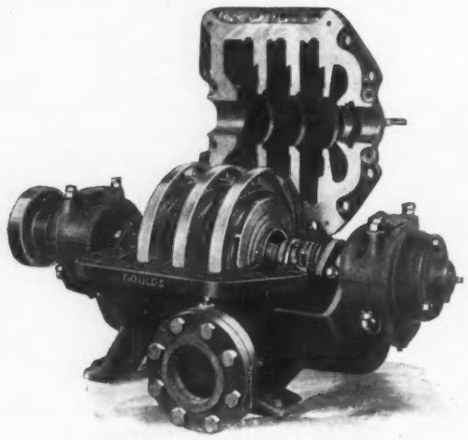
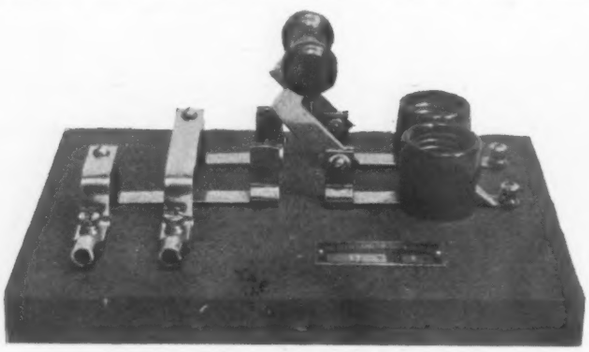


FIG. 2—INTERIOR VIEW OF PUMP SHOWING LATERAL DISCHARGE THROUGH GUIDE VANES

in oil to carry the thrust developed in actual operation. Pumps with 6-in. and 8-in. discharge and suction pipes are provided with an automatic hydraulic internal balancing disk. The pumps are built with two to five stages with ratings ranging from 200 gal. per minute to 1500 gal. per minute, and are designed for a maximum pressure of 300 lb. per sq. in. and heads of 700 ft.

Panels and Switch Bases of Oil-Impregnated Sandstone

By impregnating a special sandstone with oil the Stone Base & Panel Company, 232 North High Street, Columbus, Ohio, has produced an insulating material for which it claims many advantages over slate for switchboards, panels and switch bases. "Stonol," as the impregnated stone is called, is said to have a higher breakdown strength than slate or marble. It is homogeneous and free from the metallic veins which some-

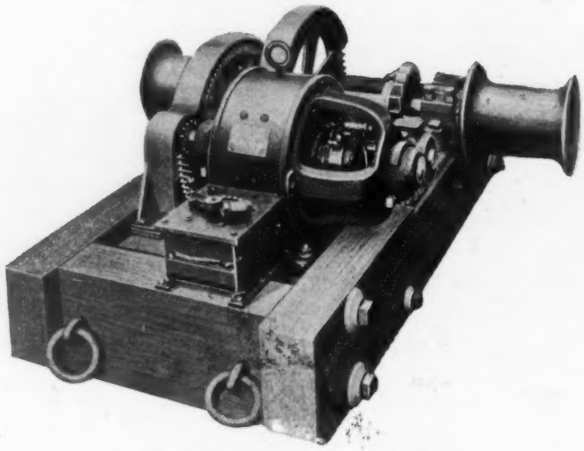


SWITCH BASE OF OIL-IMPREGNATED SANDSTONE

times occur in the other materials commonly used for panels and bases. It is lighter than slate; a piece of Stonol 1 ft. square and 2 in. thick weighs only 25 lb. As impregnated by the special method employed, for which patents have been applied for, the finished product will absorb less than one-half of 1 per cent of moisture. It is said to be mechanically stronger than slate and to be drilled more easily. The accompanying illustration shows a use of the new material made up as the mounting for a cut-out.

Portable Winch

The portable motor-driven winch shown herewith was designed originally for use in building the New York

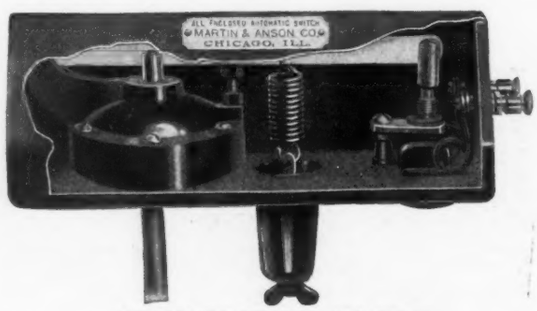


PORTABLE MOTOR-DRIVEN WINCH

subways. When used for lifting material out of the subway a trestle or light framework carrying a sheath is usually placed directly over the opening. The hoisting rope is passed over the sheath and is given two or three turns around the friction drum; the motor is then started and the slack paid off as the material is hoisted. The device can also be used to assist teams in hauling loads up heavy grades, one end of the rope being fastened to the wagon tongue and the other end given several turns around the friction drum. The winch is made in two sizes by the Dobbie Foundry & Machine Company, Niagara Falls, N. Y. The small outfit operates at a rope speed of 152 ft. per minute and the large one at 178 ft. per minute. Westinghouse compound-wound 5-hp and 7.5-hp motors are used to drive these outfits.

Automatic Switch for Air and Water Pumps

The inclosed automatic switch shown herewith is designed for use with motor-driven air or water pumps. Changes in pressures cause levers to actuate a make-



AUTOMATIC SWITCH FOR PUMP

and-break mechanism by means of a plunger resting upon a flexible diaphragm. The contacts are made with a quick action, the manufacturers declare, thus overcoming the danger of burning or arcing. The switch is inclosed by a sheet-metal hood and is made in twelve sizes or types. Pressure adjustment is accomplished by means of the thumb nut at the bottom, without re-

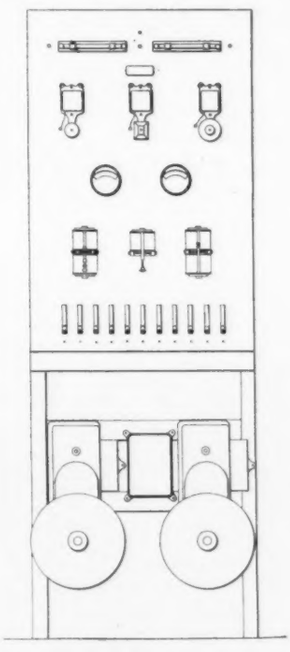
moving the hood. The larger-sized switches are provided with flanges, making them suitable for panel mounting. The devices range in weight from 5 lb. to 12 lb. and in length from 8 in. to 13 in. The automatic switch is being placed on the market by the Martin & Anson Company, 2226 Indiana Avenue, Chicago, Ill.

Steel-Covered Extension Cord

A galvanized-steel covering containing a pair of stranded insulated conductors and called "steelite" is being made by the Inland Electric Company, 14 North Franklin Street, Chicago, Ill. The cord is light in weight and is very flexible. It is designed particularly for use as an extension for portable lamps, portable electric machinery, etc. The metal covering is attached to the apparatus by means of a bushing. It is secured to the bushing by means of a sweating process. For use in breweries, packing houses, etc., or where there are acid fumes the covering is made of phosphor bronze.

Direct-Current Fire-Alarm Control Board

A control board designed for use in operating open-circuit and closed-circuit signaling systems such as fire-alarm, burglar-alarm and other battery-operated apparatus by means of high-potential or low-potential energy obtained from central-station circuits has been developed by the Metropolitan Electric Protective Company, 130 West Twenty-sixth Street, New York. The board consists of a slate base upon which are mounted terminal plates for the circuit connections and milliammeters for the different circuits. A differential relay is employed to sound signals for various locations as desired, on bells giving unlike tones. The relay is so

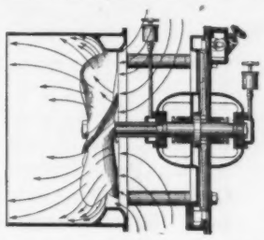


CONTROL BOARD FOR DIRECT-CURRENT FIRE-ALARM CIRCUITS

constructed that a trouble signal will be given in case a break, ground or cross occurs in the circuit or if a change of resistance takes place in the circuits with which it is connected. Use is made of a four-coil relay which is designed to eliminate destructive sparking at points of current interruption. The armature of this relay, the manufacturers assert, will move in a direction relatively opposite to that in which the energy is flowing. The armature is so arranged in relation to contact points that a trouble signal is given when it is not making contact with an upper contact point or a lower contact point. A wide range of adjustments is provided so that it is possible to give the various trouble signals which indicate the condition of the different circuits.

Inclosed Turbine Blower

A blower consisting of a propeller-type fan which is directly connected to a small steam turbine is being placed on the market by the L. J. Wing Manufacturing Company, 352 West Thirteenth Street, New York. A feature of this machine, according to the manufac-

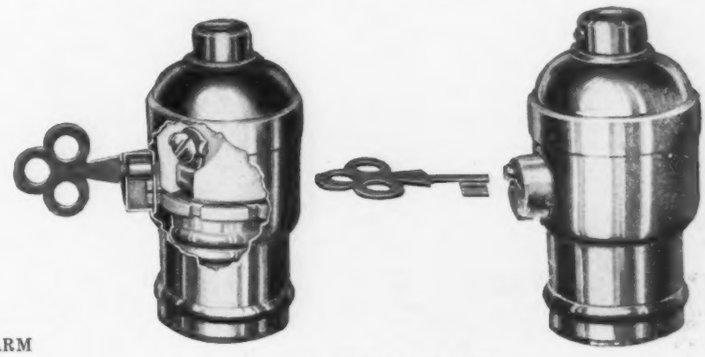


CROSS-SECTION OF BLOWER SHOWING CURVED CASING FOR DIRECTING AIR AXIALLY

turers, is a so-called expanding casing. With a propeller-type fan the air leaves the fan blade in a direction nearly radial. The casing is provided with a curved surface, as shown in the accompanying illustration, so that the course of the air is changed to an axial one, and the air is directed through the fan casing, thus eliminating, it is claimed, the air losses and eddy current losses. Pressures of 4 in., 4.5 in. and 5 in. can be obtained with this machine.

Locking Sockets and Receptacles

Improved locking sockets and receptacles of both the key and keyless type have recently been developed by the General Electric Company, Schenectady, N. Y. These sockets and receptacles afford protection to lamps in public or semi-public places, such as hotels, street cars, mills, factories, etc., where losses of lamp bulbs are liable to occur. They also prevent the theft of energy. Lamps can be inserted and removed only by

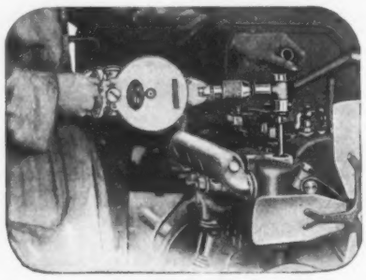


LOCKING SOCKETS

the aid of a key. When the key is removed the screw shell of the socket swivels freely, thereby avoiding injury either to the lamp base or socket if a sudden attempt is made to twist and remove the lamp bulb without the key. The sockets and receptacles are also adapted for use in residences in connection with burglar or emergency lamps controlled by a master switch.

Electric Drill for Garages

In the accompanying illustration is shown the electric drill described in the ELECTRICAL WORLD of Feb. 9, page 123, equipped with a valve reseater for automobile engines. The reseating device is attached to a chuck in the same way as a drill is fastened to the device. The



DRILL WITH ATTACHMENT FOR RESEATING VALVES

handle of the valve reseater is designed for supporting the apparatus and not to give pressure to the reseater, as the weight of the equipment alone gives sufficient pressure for the purpose. The drill can also be equipped with an attachment for sharpening drills. The Temco Electric Motor Company, Leipsic, Ohio, is making the drill.

Oil Engine for Driving Electric Generators

Oil engines of the horizontal four-stroke-cycle or two-stroke-cycle type, with ratings of from 65 hp to 1600 hp, designed to operate electric generators, are being made by the Snow Steam Pump Plant of the International Steam Pump Company, Buffalo, N. Y. The two-stroke-cycle engine is designed particularly for driving directly connected alternators, for which service, the manufacturers claim, the latter type is desirable on account of its uniform turning effort.

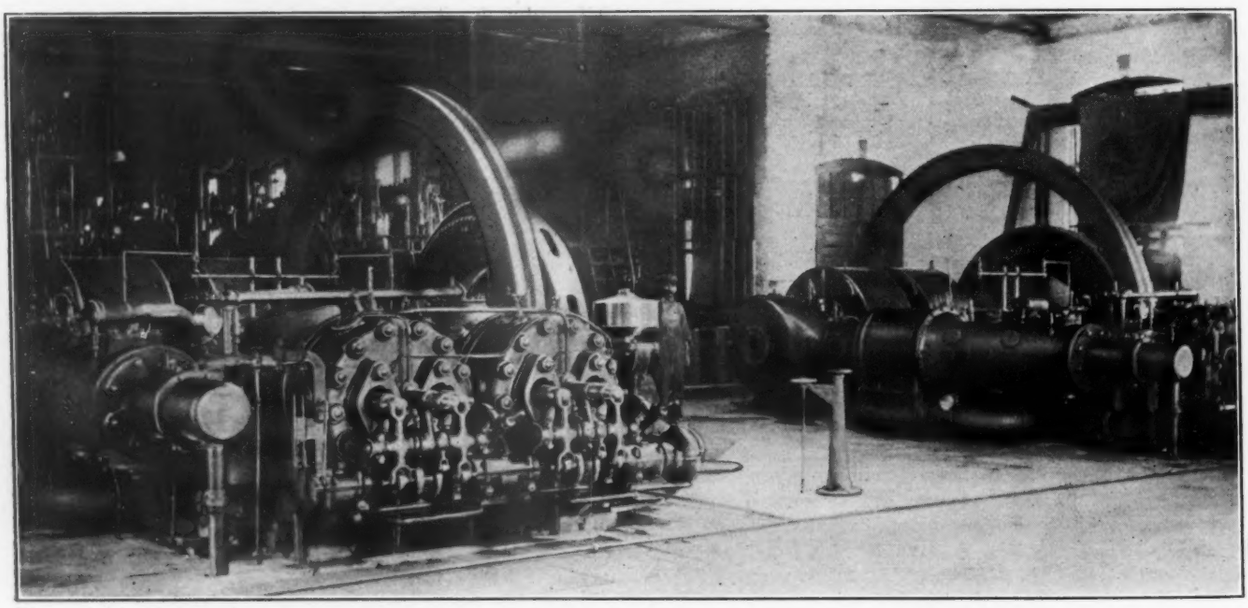
Among recent installations of the above company's oil engine are four 500-hp units in the plant of the Prairie Pebble Phosphate Company, Mulberry, Fla. These engines are of the twin-cylinder, two-stroke-cycle type and are directly connected to sixty-cycle generators. They operate in parallel with each other and also with a number of vertical six-cylinder oil engines previously installed. The amount of cross-current, it is declared, is quite low on account of the large diameters of the steel flywheels with which the engines are fitted. Two of these units are shown in the accompanying illustration.

The main frame of the engine is cast in one piece, provision being made at the outer end for two hard-cast-iron cylinder liners. The pistons are water-cooled, the water being received and discharged through telescopic tubes. The engines are provided with cross-heads, with which construction, the manufacturers assert, wrist pins of ample size are possible, and ready accessibility is afforded for the removal of the piston and cross-heads.

The main shaft is carried in the frame on three bearings, each being adjustable in all directions, so that the alignment can be easily maintained. The scavenging air is supplied by a double-acting compressor operated from a drag crank on the end of the main shaft. This compressor delivers the air to a reservoir cast in the main frame, from which it passes to the cylinders through two scavenging or inlet valves in each head. The spraying air is supplied by a three-stage compressor, arranged in tandem with the scavenging compressor. This compressor also supplies the storage tanks for the air used in starting. By means of a compression-relief device the engines are started with air at a pressure of 200 lb. per sq. in.

The 500-hp units in the Prairie Pebble plant are operated on both so-called fuel oil and Mexican crude oil, with equally satisfactory results, it is claimed, the latter oil on account of its cheapness in the Gulf district making a particularly desirable fuel.

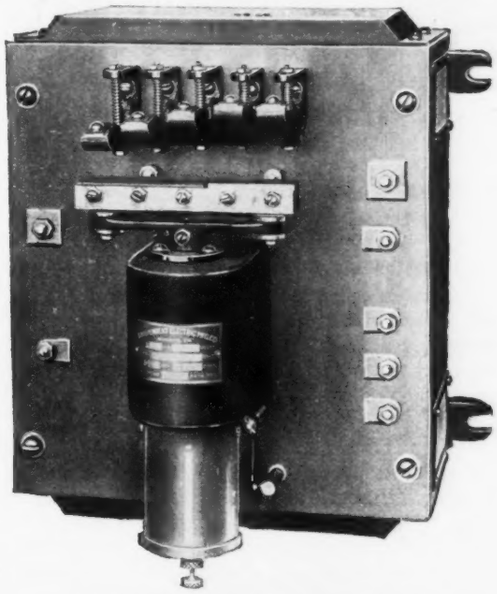
The guaranteed fuel consumption of oil engines made by the Snow Steam Pump Plant per brake-horse-power-hour is 0.5 lb. at full load. On tests and in actual operation the consumption is said to be from 10 per cent to 15 per cent lower, the fuel consumption of the four-stroke-cycle type being about 5 per cent lower than that of the two-stroke-cycle engine. One-half pound per brake-horse-power is practically equivalent, it is claimed, to a cost per kilowatt-hour of one-tenth of the price of the oil per gallon, which relation gives a ready method of calculating the fuel cost. Thus, with oil at 3 cents per gallon, the fuel cost per kilowatt-hour at full load will be approximately 0.3 cent. At less than full load the cost will be somewhat more.



500-HP OIL ENGINES DIRECTLY CONNECTED TO SIXTY-CYCLE GENERATORS

Automatic Starter for Direct-Current Motors

Several types of automatic starters for direct-current motors, one of which is shown in the accompanying illustration, have recently been placed on the market by the Industrial Controller Company, formerly the Independent Electric Manufacturing Company, Milwaukee, Wis. The starter is simple and rugged in design, the manufacturers declare, and consists essentially of a series of contact fingers mounted on a resilient material, a movable contact bar, a solenoid and dashpot, all of which are mounted on a slate base. The contact bar, solenoid core and dashpot piston are rigidly fastened together, forming a single movable part having a straight-line motion in a vertical direction. The contact bar is moved upward by the solenoid to start the motor and when released drops quickly by gravity to the "off" position. The contacts are of the "butt" type and are provided with a slight rubbing action when closing which tends to keep the contact surfaces clean. Both finger tips and contact bars are removable. The solenoid is inclosed in a cast-iron case, to the bottom of which is attached the dashpot cylinder. The dashpot is of the vacuum type and is provided with an adjustable



DIRECT-CURRENT-MOTOR STARTER

air-inlet valve which controls the time of acceleration. A portion of the vacuum chamber is provided with a bypass, thus permitting the contact bar to jump quickly to the first contact and eliminating the arcing that might otherwise occur. The acceleration can be varied over a wide range, and the adjustments can be made while the starter is in operation.

Paper Bags for Incandescent Lamps

The Continental Paper Bag Company, Whitehall Building, New York, is making special paper sacks for carrying incandescent lamps packed in corrugated cases. The lamps are placed lengthwise in the sack so that the corrugations fit into each other and prevent the bulbs from rolling around. They are thus held tightly in the sack, and, as the sacks are of a cylindrical form when filled, when they are placed next to each other only four points of any particular sack will come in contact with any other sack. Breakage is, therefore, reduced to a minimum. The sacks are made in two sizes of heavy "tearproof" manila paper. Sacks of special size and of any grade of Kraft or manila paper can be made if desired. The manufacturers declare that the sacks are proving useful not only to the electric lamp companies for delivering the lamps but also to the consumer for keeping them until they are all used. The New

BAG FOR INCANDESCENT LAMPS

York Edison Company has recently ordered a large number of these sacks. The accompanying illustration shows one of ⅛-barrel size.

Machine for Analyzing Paving Compound

In the accompanying illustration is shown a machine called the "Dulin rotarex," which is a centrifugally operated device designed for extracting bituminous aggregates from compounds utilized for paving purposes. It is especially well adapted, it is declared, for analyz-

MOTOR-DRIVEN MACHINE FOR ANALYZING PAVING COMPOUNDS

ing such compounds as bitulithic, macadam and ordinary surface mixtures. A speed-changing switch on the base accommodates the machine to various kinds of mixtures. This little machine, it is declared, does in a

few minutes the work that formerly required several hours. Samples can be taken from mixers or wagons and their composition determined before dumping and without delaying the work. The manufacturers report that the machine is used by the States of New York, Pennsylvania, Maryland, West Virginia and New Jersey. It is small and can be easily carried from place to place. A Westinghouse high-speed motor is used to operate the machine, and it is manufactured by the Braun Corporation, Los Angeles, Cal.

Phosphorescent Markers for Lamp Sockets

The Condit Electrical Manufacturing Company, Boston, Mass., has placed on the market, under the name of "Glo-balls," small glass balls filled with a phosphorescent powder like zinc sulphide which has the property of absorbing light during the day and glowing with a pale light in the dark. The balls are intended to be used as markers to aid in finding lamp sockets in the dark and are arranged to be attached to any part of the socket. A slot provides for attachment to the terminal ball of a pull-chain socket.

Flexible Couplings

Flexible couplings for shafts with diameters ranging from 0.375 in. to 20 in. are being made by the Francke Company, New Brunswick, N. J., for which the Smith-Serrell Company, 90 West Street, New York, is general sales agent. The device consists essentially of an ordinary flange coupling connected by flexible pins instead of rigid bolts. The flexible pins are of tempered-steel

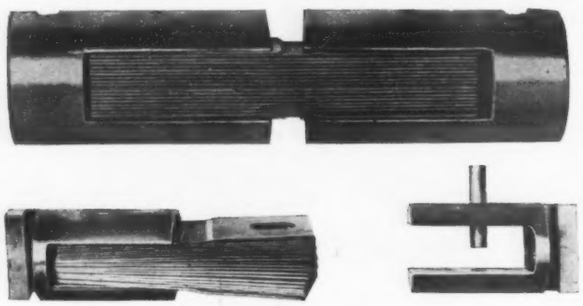


FIG. 1—FLEXIBLE PIN

strips, as shown in Fig. 1, which are held together at each end by a "keeper." Each keeper is slotted at one end to engage a spring ring which also fits in a groove in the coupling flange. The slot in the keeper is so made that the leaves are held in a radial position for driving and the keepers are stationary in respect to the coupling flanges. All strips except two short ones at each end are slotted. The short strips are stationary with respect to the keeper, making all movement come on the other tempered-steel strips. The slots allow the coupling, it is declared, to adapt itself to any misalignment. When the machines are running the strips act similarly to the leaves of a carriage spring.

For high-speed work couplings are made of forged steel and for low-speed work they are of cast iron. With a coupling of the above type, the manufacturers assert, flexibility is obtained in three directions for rectifying the results of misalignments of the shaft. The device

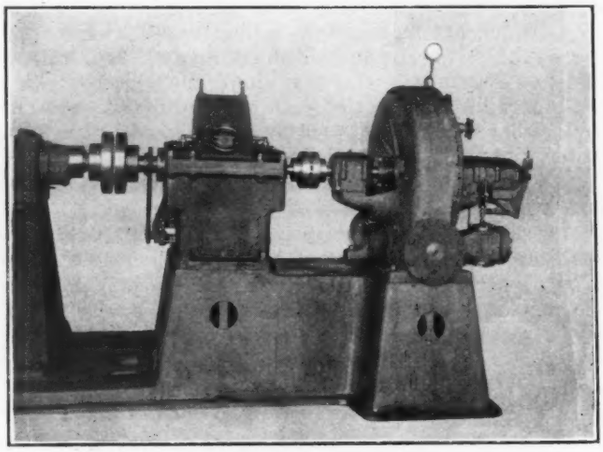


FIG. 3—FLEXIBLE COUPLING CONNECTING STEAM TURBINE TO FAN

is well adapted, it is claimed, for use with all types of directly connected machines, such as prime movers, motors and generators, blowers, compressors, pumps, crushing and grinding machinery, automobiles, motor boats and aeroplanes.

In Fig. 2 are shown a number of 27-in. flexible couplings weighing 2500 lb. each which are used for rubber-mill drive in the plant of the Firestone Tire & Rubber Company, Akron, Ohio. Some of the smaller types of couplings are also shown in this illustration. In Fig. 3 the coupling is shown connecting a steam turbine through reduction gear to a fan for forced draft.

The following advantages are claimed for the flexible coupling: It has no protruding parts to catch clothing; it is flexible in all directions, and each pin can rock, bend and slide; it provides easy means for lining the connected shafts; there is no movement or wear on the flanges; parts can be removed without moving the connected shaft; it is all metal; it allows independent endwise float of both shafts; it is noiseless; it has no backlash; it is reversible; it acts as a cushion for shock in direction of drive; the parts are interchangeable; it has a large flat surface to carry the load, there being no line or point contact; the drive is applied at the periphery; it is compact, small in diameter and short in over-all length; it is of large bore in proportion to the outside diameter; one type is suitable for any load, speed or rating of machine.

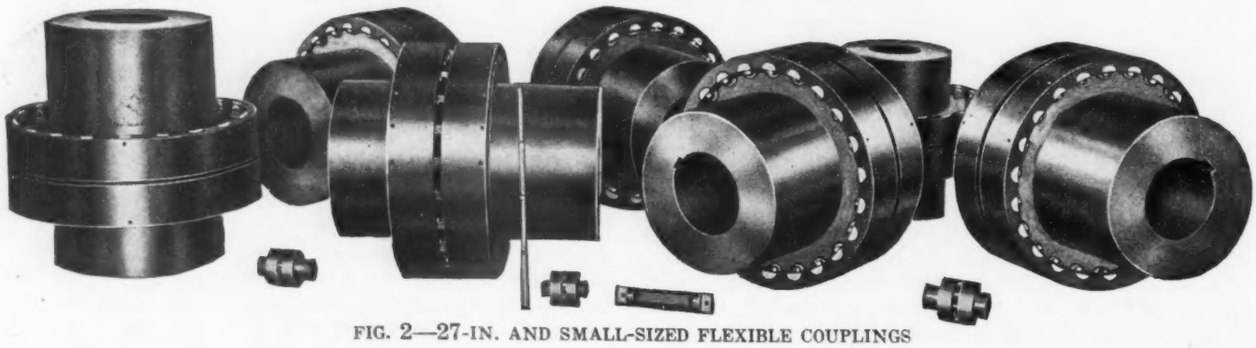


FIG. 2—27-IN. AND SMALL-SIZED FLEXIBLE COUPLINGS

Electro-Mechanical Gong

In the accompanying illustration is shown an electro-mechanical gong of improved design, which is being made by W. Ostrander & Company, 22 Dey Street, New York. According to the manufacturers, the resilient

ELECTRO-MECHANICAL GONG

hammer mechanism permits a sensitive adjustment of the trip. For each winding 475 blows are given. No hammer drop cam is used with the gong. Eighty-two of the gongs were recently ordered from the above company by the American District Telegraph Company for use in the New York Equitable Building. Two of the gongs are installed on each floor of the building.

Rural Substation in Railway-Signal Work

The field of application of the rural substation is constantly broadening as its merits become better recognized. The main features are, of course, mobility, ease of installation and low initial cost. The accompanying illustrations show views of what is said to be the first outdoor steel switch house of its type built for railway-signal purposes, and it is used in this connection by the Southern Railway at Inman, S. C., and Austell, Ga. The outdoor substation, of which the switch house is a part, effected a considerable saving in outlay, it is claimed, as compared with what would have been the cost of a substantial permanent substation to house the equip-

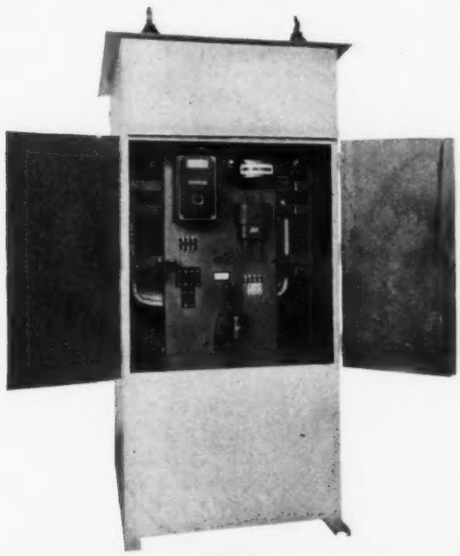


FIG. 1—FRONT VIEW OF 4400-VOLT SWITCH HOUSE FOR RAILWAY-SIGNAL WORK

ment. Each house is at the foot of a pole tower supporting the transmission line, the outdoor transformers, disconnecting switches, choke coils and lightning arresters.

The equipment of the switch houses is a little more elaborate than is usually required for motors or lighting purposes. The ordinary house, such as was recently exhibited at the Railway Appliance Association exhibition, has an oil switch only, or an oil switch and watt-hour meter, with the necessary current and potential transformers. In the house illustrated there are also an extra potential transformer, a voltmeter, a circuit-closing relay, two potential receptacles, and an incan-

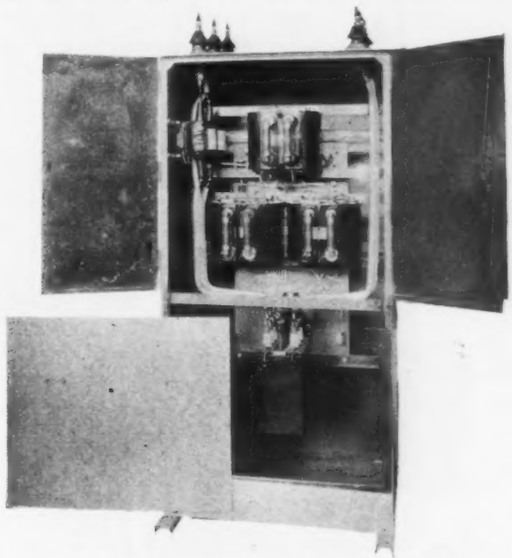


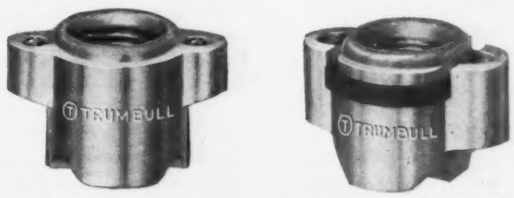
FIG. 2—REAR VIEW OF 4400-VOLT SWITCH HOUSE FOR RAILWAY-SIGNAL WORK

descent lamp with bracket. The extra transformer, two potential receptacles and voltmeter, in connection with the other two potential transformers required for the watt-hour meter, allow the voltage to be read on both sides of the oil switch before it is closed. The incandescent lamp gives illumination at night for reading the voltage or for lighting the inside of the house. The circuit-closing relay is used in the usual manner to trip the oil switch in case of overload or short-circuit.

Equipments of this kind are now being built by the General Electric Company, Schenectady, N. Y. The houses are wired complete, and it is only necessary to place oil in the oil vessels and connect the incoming and outgoing leads to the roof bushings to put them into commission.

Sign Receptacles

A sign receptacle of the screw type and another of the clamp type have recently been placed on the market by the Trumbull Electric Manufacturing Company, Plainville, Conn. The two-screw receptacle is illustrated in Fig. 1 and the clamp receptacle in Fig. 2. With the



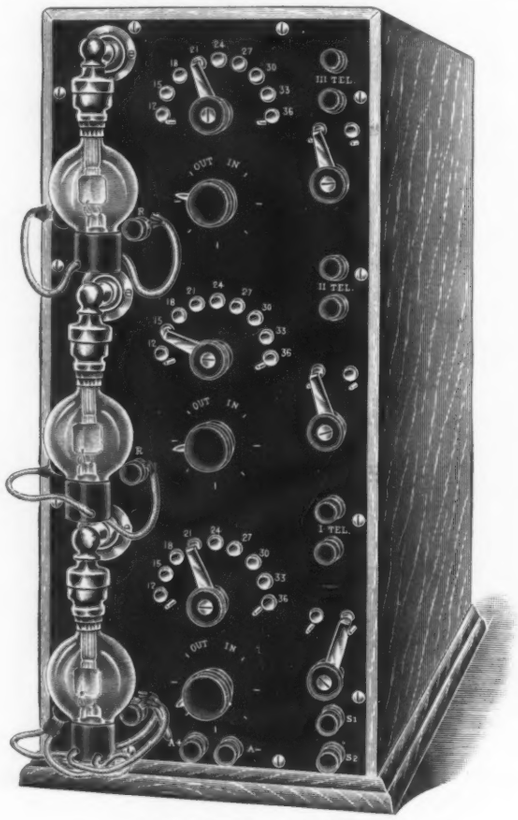
FIGS. 1 AND 2—SIGN RECEPTACLES OF TWO-SCREW AND CLAMP TYPE

clamp receptacle no screw holes are necessary, and it can be mounted in a very short time. The clamp receptacles are installed from the rear, the clamp being attached to the sign and the screws tightened so as to eliminate the necessity of the wireman reaching in front of the sign. Before tightening the screw the receptacles can be turned in any direction to line up with the wires.

Amplifier for Wire and Wireless Telegraphy and Telephony

An "audion" amplifier or "audiophone" has recently been developed which is designed to relay or amplify minute pulsating or alternating electrical impulses from five times to 600 times their original intensity without lag or distortion. It operates on the principle of cathodic dispersion. The amplifier is simple to operate, not critical in adjustment, and, according to the manufacturers, is free from all microphonic disturbances or jarring.

The amplifier is made in one, two or three steps, the latter being used where especially weak signals are to be magnified, for control of relay-actuated devices and the like. A three-step amplifier is illustrated in the accompanying illustration. The amplifier in combination with excessively loose-coupled receiving circuits or "balance" circuits affords, it is said, an effective



THREE-STEP AMPLIFIER

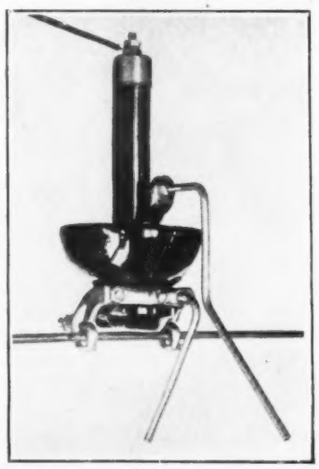
means for cutting out static interferences; it is also well adapted for receiving continuous or weakly damped oscillations, for it is possible to reduce the receiver coupling to a point where no static impulses are picked up in the secondary circuit and then to bring up the signals, which are otherwise totally inaudible, to full discernible intensity.

Bulbs of special construction and sensitiveness are used with the amplifier. The only accessory needed is a 6-volt storage battery for the amplifier or two 6-volt storage batteries for a combined detector and amplifier.

The amplifier is being made by the De Forest Radio Telephone & Telegraph Company, 101 Park Avenue, New York. The wire telephone and telegraph rights to the amplifier have been acquired by the American Telephone & Telegraph Company, and it is to a considerable extent owing to the use of this instrument, it is declared, that the recent success in transcontinental telephony has been possible.

Suspension-Type Lightning Arrester

In the accompanying illustration is shown a lightning arrester designed for 2200-volt and 6600-volt service, which was recently placed on the market by the Railway & Industrial Engineering Company, Pittsburgh, Pa. The device is called the Burke suspension-type lightning

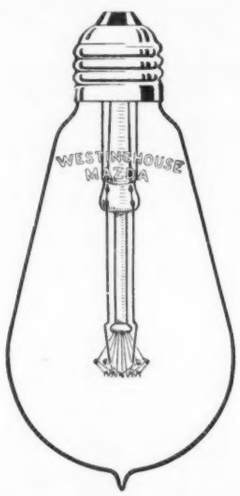


SUSPENSION-TYPE LIGHTNING ARRESTER

arrester and consists of an adjustable horn-gap with a resistor in series with the ground circuit. The arrester can be suspended directly from the transmission line, and no mounting is required. All metal parts are of brass. "Koppat" resistance material, which was described in the ELECTRICAL WORLD of Feb. 20, is used in the ground circuit to limit the flow of energy if two or more phases are discharged simultaneously.

Concentrated-Filament Tungsten Lamps

The Westinghouse Lamp Company, 1261 Broadway, New York, has just developed 25-watt, 40-watt and 60-watt tungsten lamps with concentrated-coiled-filament construction similar to that used in the large gas-filled



TUNGSTEN LAMP WITH COILED FILAMENT

tungsten lamps. The small lamps, however, are not gas-filled but are of the usual vacuum type. The new filament construction is said to increase the downward or useful light of the lamps, of which the 25-watt and 40-watt sizes are designated as type S-19 and the 60-watt size as type S-21. They are designed for 105-volt to 125-volt circuits. Their rated life is 600 hours.

CURRENT NEWS SECTION

SUPPLY MANUFACTURERS ORGANIZE

Aims and Objects of the New Association—Fifteen Governors to Control Body

On the recommendation of the committee of nine appointed to report a plan for the organization of the manufacturers of electrical supplies, the Associated Manufacturers of Electrical Supplies was brought into being at a meeting held March 9 at the Hotel Biltmore, New York City. There were represented at the meeting eighty-seven different manufacturing firms, forty-one of which became charter members of the new organization, all the others being eligible to charter membership if enrolled within thirty days.

The constitution and by-laws which were presented by the committee were adopted, after which the fifteen governors called for by the constitution were elected. The governors in turn at a later meeting elected a president, vice-president and treasurer.

Aims and Objects of Association

The official name of the new organization is, as printed above, "Associated Manufacturers of Electrical Supplies." Its objects are admirably set forth in the second article of the constitution as follows: "To advance and protect the interests of the manufacturers of electrical supplies and of the manufacturers of material entering into electrical construction, in manufacturing, engineering, safety and other problems; to promote the standardization of electrical material; to collect and disseminate information and to promote co-operation among the members."

Membership in the association is limited to corporations, firms and individuals actively engaged in the manufacture of electrical supplies or in the manufacture of materials entering into electrical construction. Each member shall have enrolled an "executive" representative and in addition may have enrolled one or more representatives who shall be known as the "associate" representatives. The executive representative acts and votes for the member in the course of the association's activities. Members owned or controlled by another member shall with such owning or controlling member have altogether only one vote, and members owned or controlled by one corporation or individual not a member shall have together only one vote. No representative can serve as an officer or governor of the association, or as a member of any of its committees, or as an officer or member of any committee of any section, after the termination from any cause of the membership he represents. The dues of executive members are $40 a year and of associate members $10 a year.

Management

The management of the association will rest in a board of fifteen governors, who shall be elected after the organization meeting in classes at the annual meeting of the association. The terms of five of the governors will expire April 1, 1916, April 1, 1917, and April 1, 1918, respectively, so that each year five governors will be elected to serve for a term of three years. The officers, consisting of a president, a vice-president and a treasurer, elected by and from the board of governors, shall serve for one year beginning April 1. The secretary, who will be appointed by the board, will hold office at the pleasure of the board. The governors are empowered to fill vacancies and choose a counsel and to fix his compensation and term of office. None of the officers will receive a salary.

The annual meeting of the association will be held on the third Thursday in March of each year.

Sections

For the purpose of accomplishing the objects of the association more effectively, the membership may be divided into groups according to the character of electrical supplies and materials manufactured. These groups shall be known as sections of the association, and members may at their option affiliate with and become members of any one or more of them in which they are interested by reason of the products they manufacture. A member not affiliating with any of the sections shall still be entitled to all other privileges of membership in the association. Membership in the sections is limited to members of the association.

The committee on organization suggested to the board of governors the formation at such times as may be expedient of the following sections among others of the new association:

Rigid and flexible conduit section.
Switch section.
Fuse section.
Fixture and glassware section.
Heating-appliance section.
Lamp section.
Socket, receptacle and rosette section.
Rheostat section.
Panel, switchboard and circuit-breaker section.
Electric-sign section.
Conduit-fittings, outlet-boxes and insulating-joint section.
Wire and cable section.
Porcelain and insulator section.
Underground-conduit section.
Dental, surgical and medical apparatus section.
Carbon and battery section.
Insulating-material, fiber, hard-rubber and asbestos section.
Instrument section.
Transformer section.

While all of these sections will not be formed at present, the probabilities are that one or two sections in those branches which are sufficiently organized and associated at present to make it possible will be formed at once; that is, the wire and cable section and the conduit-fittings, outlet-box and insulating-joint section.

The sections will be organized by the board of governors, and members can affilate with the section by application to that board. The board of governors appoints the chairman of the section and controls the action of the section as well. It may indorse or suppress the action of any section, but aside from legal questions and questions of policy each section is free to act more or less independently. Each section elects its own treasurer and secretary and provides for its own financing, separately and distinctly from the parent organization.

Four committees are provided for at present, a membership committee consisting of seven members, a

finance committee of five members, a legal committee of three members, and a publicity committee of five members.

Election of Board of Governors

After the adoption of the constitution and by-laws a committee of five was appointed to report nominees for the fifteen governors called for by the constitution. That committee at a subsequent session suggested the following fifteen persons, all of whom were elected as governors of the new organization: Messrs. Arthur W. Berresford, Cutler-Hammer Manufacturing Company, Milwaukee, Wis.; Charles Blizard, Electric Storage Battery Company, Philadelphia; Walter Cary, Westinghouse Lamp Company, Bloomfield, N. J.; LeRoy Clark, Safety Insulated Wire & Cable Company, New York; H. B. Crouse, Crouse-Hinds Company, Syracuse, N. Y.; D. C. Durland, Sprague Electric Works of the General Electric Company, New York; H. R. Holmes, R. Thomas & Sons Company, East Liverpool, Ohio; J. F. Kerlin, National Carbon Company, Cleveland, Ohio; E. Morse, Simplex Electric Heating Company, Cambridge, Mass.; James W. Perry, H. W. Johns-Manville Company, New York; W. C. Robinson, National Metal Moulding Company, Pittsburgh; Walter Robbins, Wagner Electric Manufacturing Company, St. Louis, Mo.; Robert K. Sheppard, B. F. Goodrich Company, Akron, Ohio; Gerard Swope, Western Electric Company, New York; Dr. Edward Weston, Weston Electrical Instrument Company, Newark, N. J.

Election of Officers

After the meeting adjourned the board of governors met to organize and elected the following officers of the association: President, Mr. Robert K. Sheppard; vice-president, Mr. H. B. Crouse; treasurer, Mr. James W. Perry. No secretary has as yet been appointed, but Mr. H. B. Crouse has been designated to act in that capacity temporarily.

Mr. Sheppard, who has been chosen president of the new organization, has been a leading spirit in its formation. He is manager of sales of the insulated-wire department of the B. F. Goodrich Company of Akron, Ohio. In recognition of his indefatigable work in behalf of the movement, and also as a token of their personal appreciation and esteem, the members of the organization committee presented him with a silver loving cup at the conclusion of the Tuesday morning session.

The board of governors will prepare and distribute copies of the constitution and by-laws to all those present at the meeting and to all those who may apply therefor. It will also begin at once an active campaign to increase the membership. To that end applications should be addressed to Mr. H. B. Crouse, vice-president and acting secretary Crouse-Hinds Company, Syracuse, N. Y.

Although the representative committee of business and technical experts, the account of whose appointment is given elsewhere, is not fathered by the Associated Manufacturers of Electrical Supplies, the board of governors will co-operate with the committee and provide a part of its funds. It appointed Messrs. LeRoy Clark, W. C. Bryant and R. K. Sheppard to represent the association on that committee.

It is the intention of the board of governors to co-operate in every way possible with the National Electric Light Association, the National Electrical Contractors' Association, the Electrical Supply Jobbers' Association, the two manufacturers' associations already in existence, and other bodies whose work comes within the scope of the new organization.

The next meeting of the board of governors will be held in New York on March 24.

Complimentary Dinner to J. J. Carty

Past-president Gano Dunn of the American Institute of Electrical Engineers was host and toastmaster at a dinner to Mr. John J. Carty, A. I. E. E. presidential nominee, at the University Club, New York, on March 9. Among those who discussed the appropriateness of the selection of Mr. Carty for the presidency and the excellent work done by him in the field of telephony were Secretary C. W. Hunt of the American Society of Civil Engineers, President W. L. Saunders of the American Institute of Mining Engineers, Past-president A. C. Humphreys of the American Society of Mechanical Engineers, President Paul M. Lincoln of the American Institute of Electrical Engineers, President A. S. McAllister of the Illuminating Engineering Society, President S. Taylor of the Engineers' Club, New York, President Newcomb Carlton of the Western Union Telegraph Company, President J. G. White of the J. G. White Companies, Mr. N. T. Guernsey, general counsel for the American Telephone & Telegraph Company, Mr. L. B. Stillwell, consulting electrical engineer, Mr. Herman Aaron, general counsel for the American Institute of Electrical Engineers, and Dr. M. I. Pupin, inventor of the telephone-circuit-loading coil. Mr. Carty also spoke, expressing his sincere appreciation of the great honor bestowed upon him. The dinner was attended by forty friends of the host and the guest of honor.

Experts to Investigate Concentric Wiring

At a meeting of electrical manufacturers held March 9 at the Hotel Biltmore, New York, the committee of five appointed at a previous meeting to draft nominations for a committee of commercial and technical experts to pass on the relative efficiencies of the concentric wiring system and the systems at present in use in this country made its report.

On the recommendation of the committee, the following fifteen men were appointed members of the committee of commercial and technical experts: Messrs. W. H. Blood, Jr., of the National Electric Light Association; F. V. Burton, of the Bryant Electric Company; C. E. Corrigan, National Metal Molding Company; Gano Dunn, J. G. White & Company; E. B. Hatch, Johns-Pratt Company; D. C. Jackson, Massachusetts Institute of Technology; G. S. Lawler, Association of Factory Mutual Fire Insurance Companies; Dana Pierce, Underwriters' Laboratories; W. T. Pringle, Pringle Electric Manufacturing Company; H. R. Sargent, General Electric Company; R. K. Sheppard, B. F. Goodrich Company; C. E. Skinner, Westinghouse Electric & Manufacturing Company; J. R. Strong, Tucker Electric Construction Company; J. H. Trumbull, Trumbull Electric Manufacturing Company, and a representative of the Bureau of Standards to be appointed by Dr. Stratton. To this committee the meeting added the names of the five members of the nominating committee as follows: Messrs. W. C. Bryant, of the Bryant Electric Company; H. B. Crouse, Crouse-Hinds Company; L. W. Downes, D & W Fuse Company; Gerard Swope, Western Electric Company, and LeRoy Clark, Safety Insulated Wire & Cable Company.

It was the understanding that the board of governors of the Associated Manufacturers of Electrical Supplies would co-operate with this representative committee and find the necessary funds to enable the committee to pursue its investigations. At a meeting of the board of governors of the Associated Manufacturers of Electrical Supplies held in the afternoon Messrs. LeRoy Clark, W. C. Bryant and R. K. Sheppard were appointed to represent the association on that committee. In extending financial aid the Associated Manufacturers of

Electrical Supplies expects that the work of this committee of business and technical experts will be thorough and genuine. It is also hoped that other interested bodies will co-operate with the committee and give it financial aid.

The committee will organize at once to pursue its investigation and report at a meeting to be called in New York March 23.

Progress Toward "National Electrical Week"

Sales and publicity managers met at the Society for Electrical Development headquarters, New York, on March 4 at the request of Mr. J. M. Wakeman, general manager, in pursuance of the decision of the society's executive committee to ask leading commercial men to select a steering committee for "National Electric Prosperity Week." The following were present: Messrs. H. C. Cushing, Jr., *The Central Station;* G. H. Duffield, secretary National Electrical Contractors' Association; F. R. Davis, General Electric Company; E. W. Lloyd, Commonwealth Edison Company, Chicago; Norman Macbeth, *The Lighting Journal;* A. J. Marshall, Electric Vehicle Association; H. K. Mohr, Philadelphia Electric Company; T. C. Martin, secretary National Electric Light Association; C. E. Morrison, W. S. Barstow & Company; J. C. McQuiston, Westinghouse Electric & Manufacturing Company; T. J. McManis, Edison Lamp Works; Charles W. Price, *Electrical Review;* Frank Rae, *Electrical Merchandise;* J. R. Strong, Tucker Electric Construction Company; P. L. Thomson, Western Electric Company; George Williams, Henry L. Doherty & Company; H. F. Webber, Federal Light & Traction Company; Elliott Reid, Westinghouse Lamp Company; Hugh M. Wilson, ELECTRICAL WORLD, and these members of the society's staff, J. M. Wakeman, H. W. Alexander, G. B. Muldaur, James Smieton, Jr., Theodore Dwight, A. J. Edgell, Robert N. Lee and J. P. Mallett.

Mr. Henry L. Doherty, president of the society, temporary chairman, discussed some of the work accomplished by the society and the tentative plans for "Electrical Week." Mr. E. W. Lloyd, general contract agent of the Commonwealth Edison Company, Chicago, was made chairman. Considerable discussion followed as to the proper time for such a week, this fall or in the spring of 1916. The consensus of opinion was that while perhaps a year might well be taken to get the maximum efficiency, the industry needed a revival now and, considering all conditions, this fall would undoubtedly be the best time. It was decided to leave the matter to analysis by the steering committee. It is expected that a definite date for the celebration will be fixed soon.

In the selection of a steering committee it was decided that Chairman Lloyd and the general manager of the society, Mr. Wakeman, should select a nominating committee of five, representing the varied interests, to assist in the selection of a large committee of twenty-five or more which would be representative of the country both geographically and from the standpoint of the several branches of the industry.

Messrs. Lloyd and Wakeman named as a nominating committee: Messrs. George Williams, Cities Service Company, representing central stations; Ray D. Lillibridge, Wagner Electric Company, the manufacturers; E. W. Rockafellow, Western Electric Company, the jobbers; J. R. Strong, Tucker Electric Construction Company, the contractors, and Hugh M. Wilson, ELECTRICAL WORLD, at large. This committee met on March 10 and put in a day of hard labor, but the results of its deliberations are not announced at the time of going to press.

Engineers to Discuss Amendments to New York Constitution

An informal discussion will be held at the house of the American Society of Civil Engineers in New York on the evening on March 17 with reference to such amendments to the New York State constitution as would affect engineers or their tenure of important State positions. A constitutional convention will be held in April, in accordance with the New York practice of revision at twenty-year periods. The importance of immediate action is, therefore, apparent. The society has appointed a committee, consisting of Messrs. Arthur S. Tuttle, Alfred D. Flinn and Henry W. Hodge, to study the matter. The primary purpose of the meeting is to give the committee the benefit of the views of those interested in the subject. All engineers, no matter in what branch of the profession they are specializing and whether they are members of national societies or not, are urged to attend.

Meeting of the N. E. L. A. Executive Committee

Much business was transacted at the meeting of the executive committee of the National Electric Light Association held at the headquarters in New York on March 4. The following were present: Messrs. Holton H. Scott, president; Douglass Burnett, W. C. Eglin, L. D. Gibbs, E. W. Lloyd, W. E. Long, R. S. Orr, D. R. Street, Walter Neumuller, H. A. Wagner, W. F. Wells, T. C. Martin, secretary; S. A. Sewall, assistant to secretary, and the following by invitation: G. W. Elliott, H. L. Doherty, J. M. Wakeman, J. I. Ayer and H. M. Edwards.

In the month of January receipts amounted to $28,959 and disbursements were $13,772. During the two months ended March 1, 1915, receipts from dues were $20,000 more than for the same period in 1914.

Secretary Martin presented the following membership report as of March 1, 1915: Class A, 1097; class B, 10,052; class C, 89; class D, 251; class E, 775; foreign, 38; total, 12,302. Applications were approved from 22 class A members, 1195 class B, 4 class D and 35 class E. Messrs. H. W. Wagner, assistant professor in electrical and mechanical engineering, Iowa State College, and Charles Frederick Lacomb, consulting engineer, New York, were made class C members.

Applications to form company sections were presented by the secretary from the Consolidated Gas Company of New Jersey, Long Branch, N. J.; Union Gas & Electric Company, Cincinnati, Ohio; Dayton (Ohio) Power & Light Company; Mansfield (Ohio) Railway, Light & Power Company, and Blackstone Valley Gas & Electric Company, Woonsocket, R. I. A letter has been received from the secretary of the New Mexico Electrical Association regarding the affiliation of that new organization with the N. E. L. A. Such affiliation received the approval of the committee.

Mr. Burnett spoke of the meeting held in Atlanta, Ga., on Feb. 23 for the formation of an organization of sales managers of Southern hydroelectric properties. The matter was brought to the attention of Mr. Burnett by Mr. W. R. Collier, of the Georgia Railway & Power Company. Mr. Burnett, as chairman of the Commercial Section, asked Mr. Collier to attend the meeting for the purpose of inducing those in attendance to co-operate with the N. E. L. A. Commercial Section instead of forming their own association. Mr. Collier telegraphed Mr. Burnett that, with the exception of the Southern Power Company, all in attendance were members of the N. E. L. A. and it had been decided not to form an independent association. Secretary Martin said that, although the Southern Power Company is not directly a Class A member, one or two of its constitutent prop-

erties are members and therefore the holding company has representation in the N. E. L. A.

Mr. Lloyd reported for the rate research committee and especially called attention to *Rate Research*, its bulletin. He said that the publication is not entirely self-supporting, as the 350 or 400 subscriptions do not quite meet the expense. All of the subscriptions are voluntary, as the publication has not been advertised and no effort has been made to secure new subscriptions. Mr. Lloyd thought it would be unwise to discontinue the publication, which is of great value to many member companies. It was suggested that with the exception of the editorial and actual publication work all of the business connected with it be handled in the New York office. Mr. Wagner expressed the opinion that the work of the committee and its bulletin are as important as anything the association is doing, and if the publication is not self-supporting the committee should authorize an appropriation for its continuance. As rates are connected so intimately with the commercial end of the industry, this work might be conducted under the supervision of the Commercial Section. It was decided that the publication should be continued and the business end handled by the New York office and the publication in Chicago under the general supervision of the publications committee of the Commercial Section as to publicity.

President Scott reported that Mr. H. L. Doherty and Mr. Arthur Williams have again offered prizes for the best papers presented before company sections and that he has appointed the following committee on awards: Messrs. Paul Lupke, chairman; Paul Spencer and John C. Parker.

An application for the formation of an Accounting Section, signed by eleven Class A members, and a copy of the proposed constitution were presented by Mr. H. M. Edwards, chairman of the accounting committee. The committee voted to authorize the formation of the section and that the by-laws should be submitted to the officials for approval.

A letter was received recommending that the committee take some action in connection with the principles involved in the suit brought by the fire-insurance companies against the Northumberland County Gas & Electric Company, Sunbury, Pa., as the evidence showed that the electric-lighting company did not own or put in the defective installation in the building in which the fire started but that it was the property and under the full custody of the owner of the building. The matter was referred to the public policy committee.

Mr. H. L. Doherty and Mr. J. M. Wakeman, president and general manager respectively of the Society for Electrical Development, outlined the progress of the last eight months. Mr. Doherty asked that the association co-operate heartly in the proposed national electrical week. Mr. Doherty and Mr. Wakeman were thanked for presenting the matter to the committee, and it was decided that full publicity should be given in the *Bulletin* to the proposed movement and that in this publicity it should be suggested that member companies do their part in making the week a success in their respective cities.

Mr. George W. Elliott, master of transportation, explained in detail the arrangements for special trains to the San Francisco convention and submitted copies of itineraries of trains.

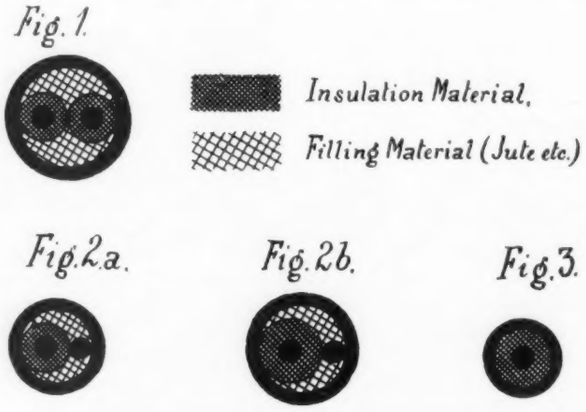
Secretary Martin made a detailed report as to various arrangements for the convention. These have been described in previous issues of the ELECTRICAL WORLD. The report was approved.

Mr. Burnett brought up, at the suggestion of Mr. Wagner, the question of settling upon two or three standard lamp voltages to be adopted as a basis for the manufacturers' output of tungsten lamps with the object of reducing by a very considerable amount the lamp stocks carried by member companies and manufacturers, as the present method apparently requires a large unnecessary investment. The matter was explained at length and, after discussion, it was decided that the plan presented several features of merit and that it should be referred to the lamp committee for further consideration and report at the next meeting.

Evolution of Grounded Concentric Wiring

At the recent meeting in Boston, Mass., of the N. E. L. A. committee on the wiring of existing buildings, Mr. S. E. Doane, Cleveland, Ohio, briefly discussed the evolution of grounded concentric wiring, stating that the points brought out below have been found helpful in disarming hostility and better acquainting electrical men with the reasons why this system is being advocated for trial in this country.

Electric wiring has been developed along two different fundamental theories. The original idea was to have a very considerable insulation which should be so strong and substantial that every danger for life and property would be removed by the large safety factor of the insulation itself. At a later time, and paralleling this theory, another theory was developed along the following lines: The insulated wire is surrounded by a grounded metallic tube. In this case a very substantial and heavy insulation is no longer so essential as under the first-named theory. Even in the case of the insulation becoming insufficient, danger for life and property will always be averted by the interposition of the grounded continuous metallic tube. In order that any danger should arise from a system of that kind two accidental damages must occur at the same time, to wit,



EVOLUTION OF CONCENTRIC WIRE

the ground of the surrounding conduit must be bad and the insulation of the wire must be injured. To obviate this, the American wiring rules declare, in Paragraph 28b, that the conduit must not only be continuous from outlet to outlet but also mechanically secured in position, and in Paragraph 28f that the metal of the conduit must be permanently and effectively grounded. Furthermore, in Paragraph 28e, it is ruled that metal conduits must have the ends provided with bushings so as to protect the wires from abrasion.

Paragraph 28f permits, however, short sections of conduit to remain ungrounded. If in such an ungrounded section or in a conduit system the grounding of which has become insufficient the insulation becomes bad, either by abrasion or by condensing water collecting inside the conduit, the conduit may become alive and danger to property or life may arise. A logical

step to obviate this is to make the conduit tight-fitting with an appropriate filling material, such as jute, to preserve the circular section of the conduit. This close fit prevents any collection of water inside the conduit, and at the same time obviates any possibility of abrasion, the insulation and the conduit being essentially fixed in their relative positions (Fig. 1). The conduit will then advantageously have a certain degree of flexibility to make insulation easier.

In this way the art advanced to the so-called "Kuhlo" or "Stannos" wiring systems, or rather to their first variety, with protective sheath. This variety is used where neither of the poles of the system is grounded.

In central stations with a grounded neutral it is possible to go one step further. As the grounded conduit and the grounded neutral wire have at most only negligible differences of potential between each other, such as may arise from the drop in the neutral wire, it evidently is unnecessary, and therefore wasteful, to insulate the neutral wire from the conduit as heavily as the potential wire. The material used for the insulation of the neutral may be either saved entirely without decreasing the factor of safety or it may be put on the potential wire with a corresponding increase of safety (Figs. 2a and 2b).

This results in a continuous grounded conduit and a grounded bare wire running inside the conduit, and there is no reason why these two conductors, both grounded and continuous, should not be united into one; in other words, why the conduit should not be used as a return circuit. The idea of using the conduit for carrying the current of the grounded return circuit is not new and has been used for many years with ordinary rigid steel conduit wiring. The difference between this idea and the concentric wiring is the fact that in the latter the conduit is close fitting, leaving no space for the accumulation of water, and flexible to a certain degree.

Thus came the logical evolution of concentric wiring (Fig. 3). The potential conductor is surrounded by an insulating coating, which in its turn is surrounded by the tubular grounded outer conductor for the return circuit. For mechanical reasons this insulating coating is covered by paper or braiding which acts as a slip member between the insulation and the sheath in case the wire is being bent. Many millions of dollars' worth of this wire have been sold abroad during the past five or six years.

Meeting of N. E. L. A. Wiring Committee

The N. E. L. A. committee on the wiring of existing buildings held a meeting at Boston, Mass., in the Edison Electric Illuminating Company's General Service Buildings on March 5, Chairman R. S. Hale presiding. Sessions extended throughout the day, those in attendance being guests of the Edison company at an electric luncheon at noon, with a dinner at the Engineers' Club, Boston, and a theater party in the evening. Included among those present were Vice-chairman S. E. Doane, Cleveland, Ohio, and Messrs. H. E. Eisenmenger, Cleveland; H. R. Sargent, Schenectady, N. Y.; C. E. Robertson, Baltimore, Md.; J. E. Latta, Chicago; F. H. Hill, Elmira, N. Y.; George Weiderman, Brooklyn, N. Y.; W. P. Lyon, Chicago; W. A. Donkin, Pittsburgh, Pa.; R. W. Hoy, Harrisburg, Pa.; F. M. Grant, Cleveland; G. B. Griffin, Pittsburgh; Theodore Dwight, New York; Paul Jaehnig, Newark, N. J., and A. J. Hixon, Boston, Mass.

Chairman Hale reported the doings at the meeting of manufacturers of plugs and receptacles in New York on March 4, and after a brief discussion the committee expressed itself in favor of the straight-pull type of receptacle as compared with the angle-pull type, on account of the decreased amount of exposure of contacts in the former equipment.

Mr. H. E. Eisenmenger then presented an exhaustive compilation of house-wiring costs in American cities in which special campaigns have been run or are now in progress. These data will be published in the committee's report to be submitted at the San Francisco convention and include returns from about fifty central stations classified geographically, showing the essential features of the various plans of capturing this class of business, including data as to price per outlet, cost of fixtures, kind of wiring, additions, deductions, terms of payment and arrangements for doing work. House wiring is now generally done by local contractors rather than by the central station. The report will also include a large number of diagrams showing graphically the comparative costs of wiring upon the basis of the data obtained. The data will be printed as an appendix to the report and illustrate a considerable range in prices which the committee does not attempt to investigate in detail but which will serve as a starting point for individual inquiries among those most interested. The committee passed a vote of thanks to Mr. Eisenmenger for his efforts in compiling the mass of material secured, and in a brief discussion of its salient features the point was brought out that between 50 and 100 out of 1500 house-wiring contracts secured by the Boston Edison company were for the minimum price of $14.35, covering a single outlet only. The committee decided to show only one set of prices per city. In most cases the central stations finance the work in such a way that the contractor is paid in net cash, the central station undertaking the collection of the instalment payments from the customer. In a few instances the central station enhances the price paid to the contractor by a small percentage in order to cover the cost of collecting and bad debts.

In considering bare concentric wiring, the committee decided to attend the forthcoming meeting of the Underwriters in New York on March 24 and 25, in support of the electrical committee's report in favor of authorizing the experimental use of this wire under proper restrictions. It was announced that the American Steel & Wire Company, Worcester, Mass., is making arrangements to test bare concentric wire and is studying what needs to be done in the design of machinery suitable for its manufacture.

Mr. H. R. Sargent, Schenectady, N. Y., said that the G neral Electric Company has now made up a complete line of porcelain fittings adapted to bare concentric wire and has practically completed an order of 5000 ft. for the Edison Electric Illuminating Company of Boston, to be "tried out" with "twist-ons" and with standard fittings. Soft solder can be applied in this class of wiring without injury to the rubber insulation, but the heat required in using hard solder renders the latter impracticable.

Mr. Sargent pointed out the unusual situation bare concentric wiring is creating with respect to manufacturing appropriations. Usually these are based on the acquisition of patents, but in this case the manufacturers are putting their development money into equipment in the open field and are backing the new material merely through their belief in its merits. In closing the discussion, Chairman Hale pointed out that several manufacturers are likely soon to take up the question of fittings design. The importance of settling upon a standard outside diameter for concentric wire of a stated size was emphasized. The General Electric Company has thus far proceeded on the basis of an outside diameter of 0.22 in. for No. 14 B. & S. concentric wire.

Mr. Hale said that the Commonwealth Edison Company, Chicago, has ordered some Stannos wire abroad, and it was announced that the Duquesne Light & Power Company, Pittsburgh, has also done this. The Brooklyn Edison company is ready to purchase concentric wire as soon as it is on the market. Mr. Hale thought that there is no question about the market among central stations in this country. The attitude of the wire commissioners in Boston, Cleveland, Detroit and New York is that concentric wire should be given a fair trial under closely controlled experimental conditions, but that its use in a broadcast manner should not as yet be permitted by the Underwriters.

The committee went over the proposed changes in the National Electrical Code, to be considered at the forthcoming meeting in New York. It was of the opinion that means should be found if possible to enable experimental installations to be made under the code, subject to proper control. The members opposed requiring insulation on grounded neutrals and favored a change in the rules to permit fuses of 10-amp rating instead of 6-amp, provided that the circuit loads do not exceed 660 watts. They also favored the use of inclosed fuses in multiple where the circuits exceed the carrying capacity of the largest approved inclosed-type fuses. The committee is opposed to the use of refillable fuses at this time. It favored the use of No. 6 wire as the smallest in grounding interior conduits containing service wires, and voted to indorse the solid neutral. The committee was opposed to withdrawing the 250-watt rating for medium-base sockets and recognizing only the 660-watt rating. It was announced that over 1500 copies of the "Standard Wiring Handbook" had been sold to members through the Commercial Section, and that the demand is increasing.

Mr. Coster on Foreign Conditions

In the opinion of Mr. Maurice Coster, manager of the foreign department of the Westinghouse Electric & Manufacturing Company, the action of the British government in extending its control of factories to works capable of being used for the manufacture of war materials will mean that orders will be sent to this country for materials of a non-military character which have been made heretofore by such factories. Mr. Coster, who returned to the United States recently from a short trip to England, said that many factories were engaged partly on government orders and partly on materials for general consumption. The power given to the government by the House of Commons on March 9 will mean that in factories of this character government orders hereafter will have precedence.

Mr. Coster said that export business is improving and that a great many inquiries are being received. He believes that conditions in South American countries are improving slowly but surely. If the crops in the Argentine Republic are satisfactory, that country will be in a much better position. Brazil also is gradually adjusting itself to the new conditions. Regarding conditions in England, Mr. Coster made these observations to a representative of the ELECTRICAL WORLD:

"During the day in London there was no sign of any difference in conditions from those that exist in times of peace. Although the city is under semi-martial law, the effects of this were not apparent in daylight. By night London is very somber. The few lamps in use are painted black on top. Occasionally automobile parties of suspicious appearance in the suburbs are held up and asked to give an account of themselves. The large hotels are as gay as ever, and a great many army officers are to be seen during week-ends.

"All the large works are engaged chiefly in making war materials. It is very sad to find drafting rooms filled with boys under twenty years of age because all older men have enlisted. All of the plants that are making war materials are very busy. The British Westinghouse plant is operated in three eight-hour shifts, making to a large extent war materials. All English manufacturers expect to make use in the future of some such slogan as 'Made in England.' I learned that a large Norwegian purchaser of electrical apparatus obtained goods in Germany on condition that he should send to Germany an amount of copper equivalent to that used in making his apparatus so as to avoid any depletion of the German supply."

Employee's and Employer's Rights in Invention

The value of patent protection and of distinctiveness in design and name were emphasized by Mr. Albert Scheible, patent attorney, Chicago, in an address March 5 before the Chicago Executives' Club, of which Mr. A. N. Fox, of the Benjamin Electric Manufacturing Company, is president. In many cases a design patent can be obtained, explained the speaker, where the novelty of construction does not justify the issue of a structural patent. Such a design patent affords the patentee the protection of monopoly and the advantage of the phrase "patented." Descriptive names or proper names appearing in a distinctive design can be copyrighted. A manufacturer can also copyright an ordinary proper name if it has been used continuously in his business for ten years or more. Discussing the rights of employees who make inventions, Mr. Scheible said that where the work is done without the use of materials or equipment belonging to the employer, and outside the regular hours of employment, the invention belongs clearly to the employee. If the invention is made in the employer's shop or with his materials, the employer has a shop right, or non-exclusive license, to use the invention, the patent being issued, however, to the individual inventor. Of the entire number of patents which are earning revenue for their owners, only about 2 per cent, said the speaker, have ever been in the courts. The fact that the other 98 per cent are quietly fulfilling their purpose disproves the general impression that a patent is but a preliminary step to legal action and test by the courts.

Springfield (Mass.) Electrolysis Investigation

Following the receipt of a 179-page report upon the electrolysis situation in Springfield, Mass., as investigated by the United States Bureau of Standards, the Springfield Street Railway Company has retained the Stone & Webster Engineering Corporation, of Boston, Mass., to make an exhaustive study of the local energy distribution system. The Bureau of Standards recommended that the railway company sell its present direct-current steam generating plant on the Connecticut River at Margaret Street, Springfield, and erect four substations in Springfield and its suburbs to be supplied with electricity by the Amherst Power Company. The plan recommended provides for the utilization by the Amherst company of the Margaret Street station as a steam auxiliary to the existing hydroelectric supply in the mid-Connecticut Valley. President J. T. Harmer of the railway company has issued a statement to the effect that as the Margaret Street station is producing energy at a highly economical rate and represents a taxed investment of $700,000, the advice of outside engineers is being sought before the company acts.

Investigators Report on New York Commissions

Governor Whitman of New York announced on March 9, after receiving reports from the legislative investigating committee, that charges of inefficiency, neglect of duty and misconduct in office will be preferred against Chairman Edward E. McCall of the Public Service Commission, First District, and Commissioners J. Sergeant Cram, Robert Colgate Wood and George V. S. Williams. Majority and minority reports were filed.

The majority find that the First District commission has not put into operation the provisions of the law for regulation in a manner which has produced the results reasonably to be expected. Certain matters, such as duplication of functions between the Interstate Commerce Commission, the city commission and the up-State commission, cannot be discussed until the investigation of the Second District body has been completed. The commissions are charged with a lack of interest in complaints, improper presentation of cases for trial, failure to enforce rulings by legal methods, ignorance in many cases of the Public Service Commission law, improper use of time supposed to be devoted to the work of the commission in the case of the chairman of the commission and one other member. The facts brought out in the investigation justify, in the opinion of six Republican members of the committee, the removal of the commissioners.

The minority report says that neglect to give attention to matters of small importance when propositions involving hundreds of millions were involved is excusable. Because the chairman of the commission gave a small part of his time to private legal practice it was unfair to say he neglected his duties, and as for the other members of the commission, the committee set up an unreasonable and humanly impossible standard of efficiency.

Organization of the Federal Trade Commission

The preliminary organization of the Federal Trade Commission will take place on Monday, March 15, upon the arrival in Washington of Mr. W. H. Parry, of Seattle, and Mr. E. N. Hurley, of Chicago. There are about thirty candidates for the position of secretary to the commission, which pays $5,000 a year. As many Washington newspaper men have received important appointments during the present administration, no surprise will be occasioned if the secretaryship to the commission is given to another member of that profession.

Information from a Washington representative of the ELECTRICAL WORLD is to the effect that Mr. Joseph E. Davies, chairman of the commission, is now wrestling with the question of retaining for the commission a general counselor, such as the Interstate Commerce Commission has in Mr. Joseph E. Folk. Such an officer of the commission, it is authoritatively said, will be necessary, that he may give advice upon many purely legal questions which will arise in connection with the administrative duties of the commission.

Perhaps the most important question that has arisen in Washington during the past week in connection with the commission is that of the extent to which it is to relieve the Department of Justice of investigations in the industrial field. In that field the department has in the past been obliged to make many investigations, upon various complaints or upon request of Congress or the President. Under the law, the department is empowered to call upon the commission to make investigations. Mr. Davies believes that the commission can be of great help to the Department of Justice. In view of the fact that jealousies have in the past existed between various government agencies at the capital, plans are being so framed as to avoid any suggestion of friction between the commission and the department.

The Department of Justice has received a mass of complaints from corporations involving the question of unfair methods of competition. None of the so-called trusts or organizations of big business has been among the letter writers. All this information is to be turned over to the Federal Trade Commission, as well as many requests that corporations have made for advice as to whether respective business moves are within the law.

Safety Rules of the Bureau of Standards

The work of the Bureau of Standards on its tentative safety rules for electrical properties is making steady progress. Dr. F. W. Stratton, director of the bureau, in an article published in the ELECTRICAL WORLD of Dec. 19, 1914, page 1188, explained the purpose of the rules and the reasons why the most earnest consideration should be given to the subject by all interested. Following the suggested policy of the bureau in this matter, many conferences have been held by its representatives with members of the various technical societies and operators of large properties chiefly concerned in the formation of a simple, understandable and workable code.

Those who have been in touch with the successive steps taken toward the draft of a tentative set of rules state that the Bureau of Standards is entitled to great credit for its painstaking study of the technical and necessary and commercial considerations involved. They state that the bureau, in pursuance of its desire to perfect rules which shall serve as acceptable standards, should be commended for its action in taking into consideration the point of view of engineers in the field who will have to adapt working conditions to whatever code may be laid down.

The feeling in the industry that, while safety is a prime consideration from many points of view, it is absolutely incumbent upon the companies to give service first with all reasonable protection has been kept in mind by those who have presented the industry's attitude in the various conferences with representatives of the Bureau of Standards. The desire of those who have attended the conferences has been to extend the fullest measure of co-operation to the bureau in order that the promulgated rules might be so representative of the needs of actual working conditions in daily practice as to assure a perfect test of their workability. To promote this end the actual conditions within the industry have been set forth fully and frankly.

In view of the attitude of co-operation manifested by the industry it is expected that the rules will be offered for general criticism before final promulgation. When the rules reach their final tentative form after criticisms shall have been considered they doubtless will be offered first for suggested practice for a serious field try-out for a period before adoption by anybody as actual working orders. In accordance with this idea, the first set of the rules to be issued by the bureau in the near future will be put out with the distinct understanding that they are submitted for actual field experience, and it is believed that this result will demonstrate better than all else the practicability of the code.

The safety rules include many ideas embraced in different construction specifications which, when prepared, provided for safety considerations; they will also suggest new ideas which appear to be designed only for safety, but which affect construction.

That the industry will give a sincere trial in helping the bureau to perfect the rules to the last degree is indicated by those who have studied the subject.

Mr. Cooper on Failure of Water-Power Legislation

Notwithstanding efforts of influential public officials in Washington, supplemented by many prominent men in the electrical industry, to secure reasonable water-power legislation, the last session of Congress adjourned without action. Mr. Hugh L. Cooper, consulting engineer, of New York, was asked by a representative of the ELECTRICAL WORLD to express his views concerning the attitude of Congress toward the proposed legislation for water-power development on navigable streams and on the public domains. While Mr. Cooper said that the subject was too broad to cover in an interview his full views, he gave what is in his judgment a partial list of the causes underlying the failure of Congress to act. Mr. Cooper said:

"An attempt was made to secure a law permitting the construction of dams in navigable streams, and, as the result of hearings before the House committee on interstate and foreign commerce, what was known as the Adamson bill was introduced in the Sixty-third Congress and, after amendments, was sent to the United States Senate, and there the bill was re-written by the Senate committee on commerce and reported unanimously by that committee to the Senate calendar under the name of the Shields-Adamson bill.

"To provide for the needs on public lands, what was known as the Ferris bill was reported by the committee on public lands of the House, was sent to the Senate and reported out by the committee on public lands in the Senate, but died in the Senate. Both of these bills failed of any action by the Senate, and the bills died with the Sixty-third Congress and will have to be re-introduced and go through the routine in the next Congress.

"The Shields-Adamson bill and the Ferris bill, as placed on the Senate calendar, represented an honest effort on the part of legislators in both the Senate and the House to prepare legislation that would protect the public interest and be inviting and protective to the investor. Both of these bills, in my judgment, could have been improved upon from the standpoint of both the public and the investor.

"There are two sets of reasons, in my opinion, for the failure of Congress to pass either of these bills. These reasons may be briefly stated as follows:

"The first and greatest reason for this failure is the fundamental one of lack of knowledge on the part of the people of the United States as to the facts regarding water-power and its relationship to the public. There is still a lingering belief in the minds of many honest men that the water-powers already developed in the United States have resulted adversely to the public interest, and while this belief is honest, the absence of facts supporting it is pitiful. The history of the so-called conservation program in the United States, briefly stated, will explain the cause of these fears.

"In October, 1907, a letter was written to President Roosevelt calling attention to what the authors believed to be a great national problem that required vigorous handling. Representations by men without previous knowledge of the subject, or without any real investigation thereof, were made that there was still undeveloped in the United States around 60,000,000 of hydroelectric horse-power, and unless strong action should be taken by way of conserving these natural resources, the United States would be robbed of a great natural possession. The sum of undeveloped horse-power used was big enough to awaken the interest of a lot of strong, well-meaning men in the United States, and the muckrakers also got busy very generally. They all made the mistake of not inquiring as to whether the foundations for their propaganda were true or untrue. For instance, their statement that there was 60,000,000 undeveloped horse-power in the United States was just as misleading, in my judgment, as it would be to state that there is 60,000,000 commercial horse-power that could be developed by going up into the air to, say, an elevation 3000 ft. above the earth and there installing rain catchers and using our rainfall at 3000-ft. head while it is on its way down to the soil. Many other statements put out by the conservationists were as faulty in respect to truth as the amount of horse-power claimed, and just as rational as the rain-horse-power suggestion.

"The conservation pioneers of 1907 and their successors have never made any inquiry, as far as I know, as to what the facts are. The original statements suit the purposes for politics and public notice, as well as the fears of the well-meaning, and it has not been considered worth while to investigate anything so useless and boresome as facts.

"The next fact that this group of conservationists has totally failed to look into is one of really much economic importance, and that is that the cost of electrical energy to the consumers in the United States has been steadily going downward for more than fifteen years, and that the cost of hydroelectric energy has been crowded down month after month for the same period of time by advances in the art of steam-power engineering, and these advances have proceeded with such successful precision that many water-powers that would have been developed except for the campaign begun in 1907 will now never be developed, or at least not until some far distant time when coal is vastly dearer than now.

"The records of the conservation program fail to disclose any effort to find out the truth about this important matter, and one of several results of the campaign up to date is the burning up of millions of tons of coal, now represented by ash heaps, and all of this with no possible compensation from the conservation or public-interest standpoint.

"A catalog of the injuries that the United States is suffering to-day because of the campaign begun in 1907 and still undisposed of would represent a list of public damages that would be appalling, but that subject is not now up for discussion.

"The second cause of the failure in the last Congress was the attitude of the administration. The administration took the view that the shipping bill was of more importance than the conservation measures, and when the shipping bill was out of the way the Philippines bill was regarded as more important than the conservation measures, with the final result that it was impossible to have either of these bills passed except by unanimous consent in the Senate. Manifestly it was impossible to secure this unanimous consent at a time when everyone was anxious to defeat an extra session. The wisdom of the administration, under the stress of the times, in urging the prior consideration of the shipping bill and the Philippines bill is not disputed by anyone, but if these bills had not been before Congress it is my opinion that fairly suitable water-power legislation might have succeeded, and a department of our engineering life, representing thousands of men and years of experience, would have been restored to fine public use and real conservation of our remaining resources would have been possible.

"In a hearing before the committee on interstate and foreign commerce on April 14, 1914, I strongly urged the committee to secure a report on the whole water-power question from a special commission of twelve army engineers, in order that Congress might have before it undisputed facts and thus be able to do careful constructive work. Until some such recommendation prevails, the remaining water-powers will not be developed according to the best interests of either public or investor."

Miscellaneous News Notes

Public Utilities Commission Proposed for Utah.—A bill providing for the creation of a public utilities commission has been presented before the 1915 session of the Utah Legislature and is now before the judiciary committee. Several public hearings have been held and many have appeared before the committee. It is urged that Utah and Wyoming are the only two states which do not now have such a commission, and that the growth of public service corporations has reached a point where regulation is necessary.

Meeting of N. E. L. A. Meter Committee.—The meter committee of the National Electric Light Association met at the Hotel Seneca, Rochester, N. Y., on March 4, 5 and 6. Messrs. C. G. Durfee, chairman, P. H. Bartlett, William Eichert and W. H. Fellows were present. The committee devoted its entire time to a revision of the "Electric Meterman's Handbook," which it is expected to issue at the time of the San Francisco convention. The committee will have another meeting in Philadelphia the latter part of March to finish the work. At that time the committee will take up the final work on its report for the convention. Although the work on the handbook is the principal part of its labor, the committee will also report on the developments of the year in meters.

Proposed Legislation Affecting Missouri Contractors.—The purpose of the electrical contractors of Missouri to secure legislation toward a state board that would license contractors and exercise supervision over them was abandoned. The time did not seem ripe, and it was seen that much preliminary work should be done to remove probable opposition. However, in Kansas City plans are being made to secure municipal regulation of electrical work, particularly to meet the local situation. The local electrical contractors and engineers hope to have an ordinance, this year perhaps, under which the men who do the work must pass examinations. The bond system for contractors probably will not be urged. The contractors want legislation under which the electrical work of Kansas City can be standardized.

The Work of the Eye Muscles and Eye Fatigue.—In ordinary reading the muscles of the eye make about 200 motions per minute, according to Prof. Morgan Brooks, of the University of Illinois, Urbana, who addressed the Electric Club of Chicago, March 4, on "Some Illumination Fallacies." The act of reading Professor Brooks compared to the exposure of the film in a moving-picture camera. Different retinal images are impressed successively as the eye visualizes one little group of words after another. This view also offers an explanation of the fact that higher intensities are needed for rapid reading. Professor Brooks has verified the point by reducing the illumination to an intensity where rapid reading was uncomfortable, although deliberate slower reading, in which longer exposures were made of each retinal image, was accomplished easily. Much of eye fatigue is attributable to the mere muscular movement of the organs of vision.

Pan-American Conference Plans.—President Wilson has determined upon May 10 as the date for the conference between bankers of this country and bankers and Ministers of Finance of Central and South America. Congress appropriated $50,000 for the entertainment of the visitors. The authority which it granted to the President provides for a conference with the Secretary of the Treasury with a view of establishing closer and more satisfactory financial relations between the Central and South American countries and the United States. Authority is given to the Secretary of the Treasury to invite in his discretion representative bankers of the United States to participate in the conference. Secretary McAdoo will invite representative financiers in order that a thorough and comprehensive discussion may be had of existing financial conditions throughout the Western Hemisphere and of the measures that should be adopted to secure financial and trade relations between the United States and its neighbors in Central and South America. The Secretary of State and all other members of the Cabinet will be asked to participate. A similar invitation will be extended to the diplomatic representatives of the various Central and South American countries and to Mr. John Barrett, director of the Pan-American Union.

Associations and Societies

Philadelphia Electric Company Section, N. E. L. A.—Dr. Silas F. Neff, president of Neff College, Philadelphia, Pa., spoke before the Philadelphia Electric Company's section of the National Electric Light Association Feb. 16 on the subject of "Self-Building and a Successful Life."

Chicago Section, I. E. S.—Dr. Nelson M. Black, of Milwaukee, Wis., addressed the Chicago Section of the Illuminating Engineering Society, Feb. 25, presenting "A Résumé of the Physical, Physiological and Psychical Phases of Vision." Dr. Black outlined the chemical theory of retinal sensitivity, and later in his talk emphasized the importance of memory and previous visual impressions as aids to the often-imperfect purely optical vision. Chairman W. A. Durgin, Dr. Henry Gradle, Dr. M. G. Lloyd and Mr. J. R. Cravath took part in the discussion.

Chicago A. S. M. E. to Discuss Ice Making.—The meeting of the Chicago Section of the American Society of Mechanical Engineers scheduled for Feb. 26 has been postponed until Friday, March 19. A dinner at 6.30 at the LaSalle Hotel, where the meeting will be held, precedes the technical program. Mr. Haywood Cochrane, of the Carbondale (Pa.) Machine Company, will present an illustrated paper on the general subject of ice making as a by-product of central stations. The discussion will be opened by Messrs. Otto Luhr, John M. Westerlin and Fred Wittenmeir.

Meeting of Connecticut Get-Together Club.—The second annual meeting of the Get-Together Club of Connecticut electrical interests was held at the Hotel Taft, New Haven, Conn., on Feb. 26. The speaker of the evening was President L. D. Gibbs, of the New England Section of the N. E. L. A., his topic being the personal effort required and expected of every man in the electrical industry. The executive committee elected for the ensuing year consists of Mr. G. B. Leland, Stamford Gas & Electric Company; Mr. W. D. Jennings, General Electric Company, New Haven, and Mr. J. O. Morris, Electric Supply & Equipment Company, New Haven.

Branch Meetings of Philadelphia Electric Section, N. E. L. A.—At a joint meeting of the meter and engineering branches of the Philadelphia Electric Company's section of the National Electric Light Association, held Feb. 2, Mr. A. Lynn Ash gave an illustrated lecture on "The Central Station Before and After the Advent of the Steam Turbine." Mr. W. C. L. Eglin and Mr. Charles Penrose spoke briefly, the latter describing the new generating station which is being constructed. At the joint meeting of the commercial and accounting branches it was decided to combine forces in a new branch known as the commercial branch. Mr. R. L. Lloyd called attention to the value of the "Electrical Salesman's Handbook." Mr. George Wentworth Carr spoke on "Administration of the Bankruptcy Law and Its Relation to Credits."

Western Society on Railroad Electrification.—At a meeting of the Western Society of Engineers, Monadnock Block, Chicago, Tuesday evening, March 16, the construction and operation of electrified railroad systems will be discussed from the standpoint of the steam-railroad engineer. Mr. W. S. Murray, consulting engineer for the New York, New Haven & Hartford Railroad, will describe the results of the single-phase electrification of 74 miles of that system, including the large Harlem River freight classification yard. Mr. Edwin B. Katte, chief engineer of electric traction, New York Central Railroad, will describe operating results of the New York Central terminal electrification, illustrating his remarks with lantern slides. Mr. R. Beeuwkes, electrical engineer of the Chicago, Milwaukee & St. Paul Railroad, Butte, Mont., will present a paper on the St. Paul's mountain-division electrification, the first 112-mile section of which is to be ready for service in October.

A. I. E. E. Industrial-Power Meeting at Cleveland.—At the industrial-power meeting of the American Institute of Electrical Engineers to be held at the Hollenden Hotel, Cleveland, Ohio, on March 18 and 19, under the auspices of the Cleveland Section, Mayor Newton D. Baker will deliver the address of welcome and the following papers will be presented: "Application of Electricity to the Ore-Handling Industry," by Mr. C. R. Gilpin; "Line Disturbance Caused by Special Squirrel-Cage and Wound-Rotor Motors When

Starting Elevators and Hoists," by Mr. J. C. Lincoln, of Cleveland; "Answers to Some Questions on Electric-Arc Welding," by Mr. J. F. Lincoln, of Cleveland; "Trouble Encountered in the Operation of Carbon Brushes on Direct-Current Generators and Motors," by Mr. E. H. Martindale, of Cleveland; "Fractional-Horse-Power Motor Load," by Mr. Bernard Lester, of Pittsburgh, Pa., and "Factors Involved in Motor Applications," by Mr. D. B. Rushmore, of Schenectady, N. Y. The technical program was arranged by the industrial-power committee, of which Mr. D. B. Rushmore, Schenectady, N. Y., is chairman. Officers of the Cleveland Section are: Mr. Howard Dingle, chairman, and Mr. R. E. Scovel, secretary, 1663 East Eighty-sixth Street, Cleveland.

Utah Electric Club.—At the meeting of the Utah Electric Club held at the Louvre Café, Salt Lake City, March 4, Judge J. E. Frick, of the Utah Supreme Court, spoke on "Prison Discipline." Mr. Lloyd Garrison is chairman of the club, Mr. L. E. Brown is secretary-treasurer, and Messrs. Leo Brandenburger and Bruce Cramer constitute the program committee.

Philadelphia N. E. L. A.—The members of the Philadelphia Electric Section of the National Electric Light Association will hold a meeting on March 16, at the New Century Drawing Room, 124 South Twelfth Street. Mr. H. A. Hornor, electrical engineer of the New York Shipbuilding Company, of Camden, N. J., will demonstrate the necessity of electrical equipment for modern battleships.

Jovians at Muskegon, Mich., Organize.—A branch of the Jovian Order has been established at Muskegon, Mich., and officers elected as follows: Mr. Eric Vachau, tribune and representative of the national organization; Mr. Edward J. Duquette, second tribune, and Mr. H. S. Nelson, secretary. For the past year electrical men in Muskegon have been banded together in a club, but not until now have they been officially connected with the national body of Jovians. There will be a rejuvenation the first week in April.

Chicago High-Tension Association.—Mr. Q. A. Brackett, of the engineering department of the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., addressed the High-Tension Association, an organization of employees of the Sanitary District of Chicago, March 3, on the subject of "Lightning Protection." Mr. Brackett described types of arresters in use and said that about $2,000,000 is expended for arrester equipment annually. Mr. J. F. Vedder is president of the High-Tension Association, and Mr. H. Koelling is secretary.

Program for Jobbers' Convention, Chicago.—The following program has been outlined for the convention of the Electrical Supply Jobbers' Association to be held at the Hotel LaSalle, Chicago, March 17 to 19: Wednesday—meeting of divisions to elect members of the executive committee, hear annual reports and elect standing committees, election of officers and committees by executive committee; Thursday—open joint meeting of manufacturers and jobbers, followed by routine meeting of jobbers; Friday—routine session, followed by visit to Hawthorne works of Western Electric Company. Among the topics to be discussed at the various sessions are the following: "Reasonably Permanent List Prices," "Relations Between Producer and Distributer," "The Relation of Turnover to Gross Profit," "A Uniform Accounting System," and "The Philosophy and Ethics of Industry." Mr. Franklin Overbagh, 411 South Clinton Street, Chicago, is secretary of the association.

New England Section, N. E. L. A., Convention.—A "question box" convention was held by the New England Section of the National Electric Light Association at the American House, Boston, Mass., on March 11 and 12. The program was informal, but provided for full discussion of live topics of central-station interest. On the first day the discussion covered problems of motive power, including steam, water and gas generators, buildings, structure, the employee, accounting, lines and the customer. An informal dinner in the evening was followed by a discussion of traffic regulations, parking facilities and charging-station problems, under the chairmanship of Mr. R. W. Rollins, of Worcester, Mass. The second day was devoted to storage batteries, accessories and electric vehicles. Mr. Welles E. Holmes, Cambridge, Mass., was general chairman of the convention. The first day's sessions were in charge of Mr. Eugene Carpenter, Newton, Mass., and the second day's of Mr. Day Baker, Boston.

Ohio New-Business Men at Dayton.—The program for the meeting of the committee on new-business co-operation of the Ohio Electric Light Association to be held at the Algonquin Hotel, Dayton, Ohio, March 17, has been announced as follows: Address of welcome by Mr. F. M. Tait, Dayton; "Application of Electric Drive in Woodworking Shops and Disposal of the By-product," by Mr. J. F. Jones, of the Wagner Electric Manufacturing Company; "Salesmanship," by Mr. R. H. Grant, National Cash Register Company; "Dressing Windows," by a representative of the Western Electric Company; "Co-operation of Electric-Motor Manufacturers with Central Stations to Secure Available 'Power' Business," by Mr. W. H. Patterson, of the Westinghouse Electric & Manufacturing Company, and "Central-Station Advertising," by Mr. E. R. Kelsey, of Toledo. A banquet and Jovian rejuvenation will follow the technical session. Mr. Thomas F. Kelly, Dayton, Ohio, is chairman of the committee on new-business co-operation of the association.

Minnesota Electrical Association.—Following is the tentative program for the convention of the Minnesota Electrical Association to be held at St. Paul, Minn., March 23 to 25: Tuesday—Address by President R. E. Brown, Mankato; report of Secretary F. A. Otto, St. Paul; address of welcome by Mayor Powers of St. Paul; paper on "Oil Engines," by Mr. Sprado of the Allis-Chalmers Company, Milwaukee, Wis.; "Financing Problems of Public Utilities," Mr. W. H. Hodge of H. M. Byllesby & Company, Chicago. Wednesday—Papers on "High-Tension Outdoor Substations"; "Watt-Hour Meters, Their Operation and Maintenance," by Mr. W. L. Wadsworth, Minneapolis General Electric Company; "Recent Developments in Electric Lamps," by Mr. Ward Harrison, National Lamp Works, Cleveland, Ohio; "Central-Station Diversity Factors," Prof. W. T. Ryan, University of Minnesota; "Work of the University Extension Bureau," Prof. George D. Shepardson, University of Minnesota; Thursday—"Friendship as a Factor in Load Building," by Mr. W. N. Mathews, St. Louis, Mo.; "Resuscitation and First Aid to Men Injured by Electric Shocks or Burns," by Dr. E. H. Whitcomb, St. Paul, Minn., and "Progress of the Safety-First Movement," by a representative of the Minnesota Labor Bureau. On Wednesday night there will be a banquet at the St. Paul Hotel, given by the jobbers of St. Paul and Minneapolis.

Co-operative Meeting in Philadelphia.—Five hundred people attended a "get-together" meeting at the Hotel Adelphia roof garden on March 5 under the auspices of the commercial branch of the Philadelphia Electric Company Section of the National Electric Light Association. Four members of the Society for Electrical Development delivered addresses. Among those present were 268 Philadelphia contractors. Mr. W. C. L. Eglin, second vice-president of the Philadelphia Electric Company, acted as chairman during the absence of Mr. W. H. Johnson, first vice-president, who was able to attend for only a few minutes. Mr. Johnson indorsed the society and its work and assured the visitors that they could always count on Philadelphia to be of assistance especially for the national electric prosperity week campaign. Mr. Eglin paid a tribute to the society and Mr. J. M. Wakeman, general manager of the society, outlined the work of the organization, what it had accomplished for the industry, and spoke of the "National Electrical Week." He pointed out that the original plan to celebrate such a week came up at a society meeting over two years ago. Since that time it had been mentioned many times, but the directors had thought it inadvisable to act until organization was completed. Now that the staff is in excellent shape, the directors have sanctioned the move. Mr. G. B. Muldaur, in charge of the field co-operative bureau of the society, stated that one of the society field staff had visited every city of over 100,000 population and also many smaller cities in the country, and that through the society's efforts harmony work had been done in various cities to bring about closer relations between central stations and contractors and dealers. Mr. H. W. Alexander, manager of the publicity department of the society, gave a lantern-slide address to illustrate the publicity work accomplished. Mr. A. J. Edgell, of the society, illustrated his address on store and window displays with lantern slides.

Public Service Commission News

Maryland Commission

The commission has filed a complaint on its own initiative against the Easton Light & Fuel Company. This action follows an investigation by the commission.

California Commission

As mentioned in last week's issue, the California Supreme Court has sustained the right of the commission to refuse the Oro Electric Corporation a permit to do business in Stockton in competition with the Western States Gas & Electric Company. The decision of the commission says in part:

"The city of Stockton did not, when the public utilities act was passed or when it became effective, have power to grant to electric corporations franchises permitting them to furnish electricity to the inhabitants of the city, if, indeed, it had the power to grant the limited franchise or right to use the streets for that purpose. It follows that the requirement of a certificate of public convenience and necessity contained in Section 50 of the act did not impair any power of control vested in the city. The conclusion disposes of the case, since it compels the holding that the Railroad Commission did not exceed its jurisdiction in taking cognizance of the application of the petitioner for a certificate or in denying such certificate."

The commission, in a statement concerning the decision, said: "It means that the policies of the commission, based on a State-wide view, cannot be thwarted by purely local considerations, and that henceforth the commission will not necessarily be bound to permit the impairment of an existing public utility service, if it is just and reasonable, by admitting a new public utility into the field unless the interests of the public clearly so require."

The commission has provisionally authorized the Southern Sierras Power Company, operating in the counties of Inyo, Kern, Riverside and San Bernardino, to issue $300,000 of 6 per cent twenty-five-year bonds.

At the hearing it developed that a close relationship, amounting to a practical identity of control, existed between the Southern Sierras Power Company, the Nevada-California Power Company and the Sierras Construction Company. It was further developed that the properties of the Southern Sierras Power Company were built by the Sierras Construction Company under contracts by the terms of which the construction company charged the power company with the full cost of the work and added thereafter 15 per cent as a profit to the construction company.

Also, it appeared that the Nevada-California Power Company has an arrangement with the Southern Sierras Power Company for the sale and interchange of power which is covered by a series of contracts. The commissioner who heard the case says:

"In view of the situation herein found to exist, I recommend that a final order be granted to this applicant to issue bonds only after it shall have adjusted its accounts with its affiliated and associated corporations, to the end that any profit heretofore made or proposed to be made by any such affiliated or associated corporations at the expense of this applicant be eliminated."

Ohio Commission

Representative Frank Reighard has offered a bill in the Ohio Legislature which will change the law requiring physical valuation of public utility companies for rate-making purposes. This bill strikes out the mandatory clause and leaves it to the judgment of the commission as to whether or not a valuation shall be made. The commission must determine through a hearing whether it would be necessary to make a valuation, and then the order may or may not be issued.

Senator L. E. Myers, of Marion, has introduced a bill in the Ohio Legislature which is of an enabling nature and is intended to give the city of Bellefontaine the right to sell the product of its municipal plant to public institutions and other consumers outside of its corporate limits. It provides that rates for such service must be sufficient to pay all operating expenses, maintenance, depreciation, repairs, losses, damages and interest at 5 per cent per annum on the cost of acquiring, constructing or extending such work. As the bill is of a general nature, these requirements would be effective in all cities and towns where municipal plants are established. Mayor Newton D. Baker of Cleveland has pronounced the bill unscientific and unsound and predicted that it will not pass. Both he and Commissioner of Light and Heat Ballard said that it cannot hurt the Cleveland plant, except in its extensions, since it has already been completed, but that other such enterprises would perhaps be impossible with the law in effect.

New York Commissions

The Second District Commission has authorized the Northern New York Power Corporation to issue $900,000 of 6 per cent first mortgage bonds at not less than 97, to net $873,000. Of this $350,000 is to be paid in cash to the Columbia Mills for its water rights, property, etc., and $455,000 is to go for the completion of the hydroelectric development. In addition the corporation is to issue $500,000 stock. This, at 125, is to be turned over to the Columbia Mills, in payment of the balance on the property transferred. The commission further approves the lease of the property thus acquired and developed to the Niagara, Lockport & Ontario Company. In approving the franchise for the delivery of electrical energy to the Niagara, Lockport & Ontario Company system and the supply thereof to the Columbia Mills' present customers, the commission compels the companies to stipulate that they will not interfere with the business of the People's Gas & Electric Company in Oswego.

The Second District Commission has approved a new link in the chain of power transmission lines in the northern part of the State by approving franchises of the St. Lawrence Transmission Company to extend its lines from Norfolk to Hannawa Falls, there connecting with the line of the Northern Power Company, and from Massena north to the Canadian border, where connection is made with the lines of the Cedars Rapids Transmission Company of Canada. The commission limits the use of these lines to transmission purposes only, through the villages of Norwood, Massena and Potsdam and the towns of Pierrepont, Potsdam, Norfolk, Stockholm and Massena, for which the company holds franchises, but in which other local companies are already doing a distributing business with the approval of the commission.

The Second District commission has rendered a decision on the petition of the Mongaup Light, Heat & Power Company, Inc., for permission to construct and exercise franchises in competitive territory and to issue stock. The present operating company has received authority to issue bonds for an extension to the territory in question. The new company proposed to develop hydroelectric energy, but the testimony leaves the commission in doubt as to the value of the installation for continuous service. "It seems clear," says the commission, "that utilizing such water-power for part of the year and keeping a steam plant in reserve would so increase the cost of operation as well as the cost of investment as to make it very doubtful whether the limited custom which would be obtained by the petitioner would make the venture in anywise profitable. Moreover, the petitioner's arrangements for various involved water rights do not appear to have been fully completed."

The commission is not convinced that the Murray Electric Light & Power Company, which has franchises for the territory, has had sufficient opportunity to make extension which will afford the desired service. It therefore holds that in this thin territory the Murray company should not be subjected to competition if it can be ready within a reasonable time to make the necessary extensions. The commission is satisfied that the introduction of another company and competition would be entirely experimental, with much doubt as to the ability of the new company to succeed even though hydroelectric energy may be properly and satisfactorily improved, and the commission is certain that the results to the Murray company would be disastrous so far as its operations in that territory are concerned. The commission closed the case with leave to the petitioner to ask for a reopening on or after Dec. 1, 1915, upon showing that the Murray company has failed to make extensions to Hurleyville and Fallsburgh and has failed to accept and act under a new franchise from Centerville Station.

Personal

Mr. R. D. Newell, who for the past nine years has been superintendent of the meter department of the Edison Sault Electric Company, has succeeded Mr. Walter B. Casler as manager of the Northern Electric Company, Sault Ste. Marie, Mich.

Mr. William S. James, who for eight years has been connected with the Frederick (Md.) Gas & Electric Company and the gas and electric department of the Hagerstown & Frederick Railway Company, has been appointed to the newly created office of new-business manager of the gas and electric department.

Mr. A. B. Weeks, for some time connected with the Niagara Falls Power Company, regarding the early history of which he wrote much for the technical press, has resigned his position with the Packard Electric Company, with which he has been connected for seven years. Mr. Weeks has made a special study of insulating varnishes

Mr. Edward N. Hurley, who has been appointed a member of the United States Federal Trade Commission by President Wilson, is president of the Hurley Machine Company, Chicago, and also president of the Illinois Manufacturers' Association. He has been a leader in the work of the latter organization and in its efforts to bring American manufacturers into touch with the buyers of South America. In addition to the interests mentioned Mr. Hurley is president of the First National Bank of Wheaton, Ill., a director of the Chicago & Great Western Railroad and has holdings in the Independent Pneumatic Tool Company and the Aurora Automatic Machine Company. He is well known in electrical circles.

E. N. HURLEY

Mr. O. A. Honnold has resigned as electrical engineer of the Utah Light & Traction Company, Salt Lake City, Utah, until recently the Utah Light & Railway Company. Mr. Honnold was graduated from Purdue University. After two years in power-house construction and operation with the Citizens' Street Railway, Detroit, Mich., Mr. Honnold in 1896 took charge of miscellaneous engineering and operating work and helped to carry out the consolidation of several power companies and street railways in Salt Lake, Ogden and vicinity. After the late Edward H. Harriman bought out the light, power and street-railway interests in 1906, Mr. Honnold did the electrical engineering work and had charge of all electrical construction and reconstruction in connection with rebuilding the old properties. He also had charge of all of the stations and transmission lines and distribution operating departments. In resigning from the Utah Light & Traction Company Mr. Honnold concludes nineteen years of work at Salt Lake, with the exception of two years, from 1900 to 1902, when he was with the Lachine Rapids Hydraulic & Land Company, at Montreal, Can. Between $7,000,000 and $8,000,000 was spent in improvements made on the property under Mr. Honnold's supervision at Salt Lake from 1907 up to 1914. Mr. Honnold expects to spend several months in taking a vacation and will then look after his own interests in the West.

Mr. W. R. Hall, manager of the Anniston Electric & Gas Company, Anniston, Ala., has been appointed manager of the North Alabama Traction Company, New Decatur, Ala. Several years ago Mr. Hall was the general manager of the company at New Decatur. He then became general manager of the Sheffield (Ala.) Company. Subsequently he became connected with the Anniston Electric & Gas Company as general manager.

Mr. Charles C. Elwell has been named a member of the Public Utilities Commission of Connecticut to succeed Mr. Theodore B. Ford, Bridgeport. Mr. Elwell at present is engineer of the commission. Mr. Elwell was born in 1855, at Belfast, Maine, and is a graduate of the University of Maine. He has had a very wide experience in railroad work and prior to becoming engineer to the commission was engineer of the Connecticut Company.

Mr. Karl E. Van Kuran, who has been appointed district manager of the Westinghouse Electric & Manufacturing Company for Southern California, was graduated from the University of Washington in 1904 with the degree of B.S. in electrical engineering. He obtained his early training in the electrical field with the Stone & Webster Engineering Corporation in Seattle. In the fall of 1904 he entered the employ of the Westinghouse company as apprentice. After serving two years' apprenticeship he was transferred to the sales department in East Pittsburgh, where he filled various minor positions until 1911, when he was transferred to the Los Angeles office as assistant district manager. Mr. Van Kuran has been an active Jovian and has done much to promote the work of the Jovian Electrical League in and about Los Angeles.

Obituary

C. A. Newcomb, president of the Anderson Electric Car Company, builder of the "Detroit Electric," died suddenly at his home in Detroit March 9, at the age of seventy-eight.

John Cassidy, builder of the first railroad telegraph line in California and an associate of Mr. Alexander Graham Bell, died in Honolulu March 9, at the age of seventy-one.

Herbert A. Davidson, for the past ten years chief engineer of the Edison Electric Illuminating Company of Brockton, Mass., died at Saranac Lake, N. Y., on March 4. Mr. Davidson was born in Brockton forty-two years ago and had been in the employ of the Edison company, one of the Stone & Webster properties, since 1891. He went to Saranac Lake about a month ago. He is survived by his widow and three children.

E. G. Bernard, who died, as announced in last week's issue, at Troy, N. Y., Feb. 23, began his electrical career in 1879 at the age of seventeen, his first electrical experience being gained in installing an arc-light plant in New York City for Booth's Theater in that year. With the appearance of the incandescent lamp he at once entered into isolated-plant lighting, which field he was probably the first to work systematically as a salesman and also as an engineer in the development of constructional details. In 1884 he became chief sales agent and constructing engineer for the Sawyer-Mann company, continuing in the same capacity with its successor, the Consolidated Electric Light Company. When the latter was purchased by the Westinghouse company, about 1888, he remained in charge of the textile-mill work until shortly before establishing his own business at Troy in the fall of 1890. A few years after starting business in Troy, Mr. Bernard began the manufacture of dynamos and motors specially adapted to his line of work, which he continued until satisfactory machines could be obtained elsewhere. His electrical activities covered a wide range, including in early days town arc and incandescent lighting. Much of his work has been special in character, such as the installation of 7000 lamps in the Capitol at Albany in twenty-five working days, practically all of this work being special construction; the generator and motor equipment of the United States Arsenal at Watervliet; marine installation work for the United States Navy and for shipyards, etc. Mr. Bernard joined the American Institute of Electrical Engineers in January, 1886, and was a member of many electrical bodies, including the Electrical Supply Jobbers' Association. For a quarter of a century or more he was a regular attendant at conventions. He was president of the Troy Electrical Company, successor to the E. G. Bernard Company.

E. G. BERNARD

Corporate and Financial

Alabama Power Bond Issue.—Harris, Forbes & Company, of New York, are offering at 101 and interest $2,000,000 Alabama Power Company first mortgage three-year 6 per cent gold bonds due on Feb. 1, 1918.

Cedars Rapids Manufacturing & Power Directorate.—At the annual meeting of the Cedars Rapids (P. Q.) Manufacturing & Power Company, Sir Herbert S. Holt and Morton Otis, of London, England, were elected directors.

Buffalo General Electric Bond Offering.—Lee, Higginson & Company, of New York, are offering $450,000 of first refunding 5 per cent gold bonds of the Buffalo General Electric Company due April 1, 1939, at 99¾ and interest.

San Diego Consolidated Gas & Electric Debentures.—William P. Bonbright & Company, of New York and Boston, are offering at 98 and interest to net 6.33 per cent 6 per cent debentures due on Dec. 1, 1922, of the San Diego (Cal.) Consolidated Gas & Electric Company.

Empire Gas & Electric Bonds.—W. C. Langley & Company, of New York, are offering at 93½ and interest to net 5.47 per cent $100,000 of joint first and refunding mortgage 5 per cent gold bonds of the Empire Gas & Electric Company, Auburn, N. Y., and the Empire Coke Company, due on March 1, 1941.

Baltimore Consolidated Convertible Note Issue.—Alexander Brown & Sons, of Baltimore, Md., are offering at 98 and interest $2,500,000 of Consolidated Gas, Electric Light & Power Company of Baltimore 5 per cent two-year convertible gold notes, dated March 15, 1915. Holders have the right up to and including Dec. 15, 1916, to convert the notes into common stock at 115.

Electric Bond & Share Preferred Stock.—Preferred stockholders of the Electric Bond & Share Company, of New York, have been offered the right to subscribe pro rata for 10,000 shares of the company's preferred stock at par plus accrued dividends. No subscriptions will be received after April 15, 1915, after which the unsubscribed stock will be sold to bankers who have agreed to purchase it.

Northwestern Electric Preferred Stock Offering.—The Northwestern Electric Company, of Portland, Ore., offered to the general public $1,200,000 of 6 per cent cumulative preferred stock at 82½. Of the entire issue of $2,000,000, $800,000 had previously been taken by California investors. The proceeds will be used to retire short-term 6 per cent gold notes issued to complete the electric generating plant and distributing system.

Utah Valley Gas & Power Sales.—E. W. Brooks & Company, of New York, have purchased properties of the Utah Valley Gas & Power Company, of Provo, Utah, and have transferred them to the newly incorporated Utah Valley Gas & Coke Company, directors of which are Messrs. A. W. Brooks, Fred W. Freese, chairman of the board; W. H. Brereton, Thomas F. Pierpont and A. F. Beringer, secretary-treasurer and general manager.

Ottawa Municipal Report.—The report of the Ottawa municipal electric plant for 1914 shows gross revenue of $202,911, from which were deducted charges for operation, interest and sinking fund, leaving a gross surplus of $42,448. From this there was deducted $32,500 depreciation of plant, leaving a net surplus of $9,948, which was carried to capital account for depreciation, renewals and extensions. Total assets of the department were $972,742.

Sale of Collateral for Notes of Great Shoshone & Twin Falls Company.—The Commonwealth Trust Company of Pittsburgh, trustee for the defaulted three-year 6 per cent collateral-trust gold notes of the Great Shoshone & Twin Falls Water Power Company, has given notice that, at the request of holders of a majority of the notes, it will offer for sale at its office, April 14, the collateral for these notes, consisting of $1,500,000 of the company's first mortgage 5 per cent bonds.

Central Massachusetts Light & Power Preferred Stock.—C. D. Parker & Company, Inc., Boston, Mass., are offering to net over 5.7 per cent tax-exempt preferred shares of the Central Massachusetts Light & Power Company. The shares are entitled to dividends of 5½ per cent for the two years ending May 15, 1916; 5¾ per cent for the two years ending May 15, 1918, and 6 per cent thereafter, and to share equally with common stock after payment of common dividends of $6 per share in any one year.

Holyoke Municipal Report.—The annual report of the gas and electric department of the city of Holyoke, Mass., for 1914 shows the following for the electric department:

Income from energy	$335,500
Manufacturing cost	$137,333
Distributing cost	31,327
Commercial and general expense (less premium on bond issue)	80,834
Total expense	$249,494
Net profit from electrical energy sales	$86,006

Consolidated Gas Company Bonds.—To show the investment position of the underlying issues of New York City utilities, Parmelee & Company, of New York, have prepared a circular showing the capitalization and territories served by the Consolidated Gas Company, which owns or controls through stock ownership all of the gas, electric-light and power properties operating in the boroughs of Manhattan and the Bronx, Westchester County, and portions of Long Island. The bankers are preparing other circulars to cover bond issues of other New York City utilities, including the Kings County Electric Light & Power Company.

Electrical Utilities Investment.—William P. Bonbright & Company are circulating a pamphlet on the record and progress of electrical utility investments. The booklet shows how the utilities have responded to scientific methods, explains the alliance of gas and electrical energy, and records the growth of investment in electrical properties. Safety of capital, dependable income, the stability of earnings during the 1907 panic, the similarity of public utility bonds to municipal bonds, the labor problem, the day load, diversity factor, commission service and lack of competition are given as reasons for investing in public utility securities.

The Yadkin River Power Annual Report.—The annual report of the Yadkin River Power Company for the year ended Dec. 31, 1914, showed 1388 electric customers and an output of 63,962,594 kw-hr. The accompanying statement shows the income. The company is a subsidiary of the Carolina Power & Light Company:

	1914	1913
Gross income	$299,606	$260,206
Operating expenses and taxes	98,862	77,213
Net income	$200,744	$182,993
Interest on bonds	175,000	175,000
Other interest	10,449	8,410
Balance	$15,295	*$417

*Loss.

Elevated Stock Purchase of Commonwealth Edison Attacked.—Mr. J. B. Hogarth, of Chicago, has filed complaint with the Illinois Public Utilities Commission, Springfield, Ill., alleging that the Commonwealth Edison Company of Chicago, in purchasing stock of the Chicago Elevated Railways and issuing $7,000,000 of 5 per cent notes, violated Sections 21 and 27 of the Illinois public utilities law. Mr. Hogarth declares that the resulting interest burden of $350,000 yearly interferes with just and equitable rates. In a later petition he attacks the financing of the Chicago Elevated Railways. In the annual report of the Commonwealth Edison Company for 1914, issued recently and abstracted on page 572 of our issue of Feb. 27, the company sets forth fully the reasons for the issue of the notes.

American Cities Annual Report.—The annual report of the American Cities Company, of New Orleans, La., showed the accompanying statement for the combined constituent companies. Messrs. C. Harvey, of Knoxville, and S. J. Dill, W. G. Weiss and D. D. Curran, of New Orleans, were elected directors to succeed Messrs. Irving Bonbright, A. J. Hempill and S. Z. Mitchell, of New York, and W. M. Kavanaugh, of Little Rock:

	1914	1913
Gross earnings all sources	$14,822,105	$14,680,302
Operating expenses and taxes	9,133,582	9,117,986
Net earnings	$5,688,523	$5,562,316
Interest, bond discount, amortization and miscellaneous	3,480,973	3,347,799
Applicable to dividends	$2,207,550	$2,214,517

Dominion Power & Transmission Company's Report.—The annual report of the Dominion Power & Transmission Company, Ltd., Hamilton, Canada, for the year ended Dec.

31, 1914, stated it would probably be advisable to complete the steam-power station, work on which had been discontinued for the time being owing to existing conditions, and install the plant during the coming summer, in order that at least one or two units might be in operation before another winter. The statement for the year follows:

Gross earnings		$2,395,967
Operating expenses		1,390,847
Balance		$1,005,120
Transferred to maintenance and renewal account		101,023
Balance		$904,097
Bonded interest and interest		377,106
Surplus earnings		$526,991
Surplus balance on 1913		955,862
Total		$1,482,853
Dividends declared		461,392
Written off for bad debts		1,056
Surplus balance		$1,020,405

Harwood Electric Annual Report.—In its annual report for the year ended Dec. 31, 1914, the Harwood Electric Company, Hazleton, Pa., gives the number of customers as 5517, an increase of 707 over the previous year. The output was 28,917,325 kw-hr., or 5,838,100 kw-hr. more than in the preceding year. The results of the business for the year just ended are as follows:

Operating revenue		$429,903
Operating expenses		236,439
Net operating revenue		$193,464*
Non-operating income—revenue:		
Investments	$44,398	
All other sources	10,849	
		55,247
Gross income		$248,711
Interest on funded debt	$178,070	
Interest on other liabilities	21,674	
Amortization of bond discount	10,911	
		210,655
Net income carried to profit and loss		$38,056*

*Note.—No allowance for depreciation, other than reserve for depletion of coal and depreciation of office furniture and motor-car equipment since organization of company March 1, 1912.

Electric Bond & Share Statement.—A comparative income statement of the Electric Bond & Share Company from March 15, 1905, to Dec. 31, 1914, shows gross income of $8,614,681 and net income of $6,524,659. During that period preferred dividends were $1,419,725 and common $1,388,333. The total surplus is $3,716,601. The statement for the year ended Dec. 31, 1914, is as follows:

Gross income		$1,558,521
Expenses		421,479
Net income		$1,137,042
Dividends:		
Preferred stock		$298,392
Common stock		400,000
Surplus income		$438,650
Surplus brought forward		3,277,951
Total		$3,716,601
Net changes in surplus		538,497
Net increase in surplus to Dec. 31, 1914		$4,255,098
Surplus at beginning of business March 15, 1905		440,599
Total		$4,695,697
Special dividend on common stock paid in 1913		1,500,000
Surplus and undivided profits Dec. 31, 1914		$3,195,697

Holton Power Earnings.—The income account of the Holton Power Company, Holtville, Cal., for the year ended Dec. 31, 1914, follows:

Operating revenue		$184,013
Operating expenses		157,687
Net operating revenue		$26,326
Non-operating revenue		36,258
Gross corporate income		$62,584
Deductions:		
Non-operating expense	$2,017	
Interest	57,203	
Miscellaneous	58	
		59,278
Surplus for year 1914		$3,306
Balance Dec. 31, 1913		34,639
Total		$37,946
Additions to surplus		7,528
Balance		$45,474
Deductions for year:		
Dividends, sinking-fund appropriations and other appropriations		30,752
Surplus Dec. 31, 1914		$14,722

Manufacturing and Industrial

Business of British Electrical Company Increases.—It is reported that since the war began the British Thomson-Houston Company, Rugby, England, has noted a large increase in business. This increase, it is declared, is due to the cutting off of German competition. The above company is a subsidiary of the General Electric Company.

The Schaeffer & Budenberg Manufacturing Company, Brooklyn, N. Y., recently moved into its new concrete seven-floor building, with 10,000 sq. ft. to the floor, at Berry Street and South Fifth Street. The above company is affiliated with several large European concerns and was established in 1878. It is manufacturing various types of thermometers, gages, time recorders, tachometers, etc.

Special Campaign for Heating Appliances.—The Hotpoint Electric Heating Company, Ontario, Cal., has set aside the week of May 3-8 to push its new "El Grilstovo," and will designate the period as "Hotpoint week." The company is sending samples of the stove to dealers, and during the above week the device will be sold at a special discount. For five years the Hotpoint company has inaugurated such a special selling campaign, although prior to last year only one day was set aside for the purpose.

Amplifiers for Wireless Service.—The De Forest Radio Telephone & Telegraph Company, 101 Park Avenue, New York, is disposing of a large number of its amplifiers for both wire and wireless telephone and telegraph service. These amplifiers are now being used by the United States government in its radio stations and on a number of its warships. It is also being employed by the British and Japanese government. The wire telephone and telegraph rights to the amplifier have been acquired by the American Telephone & Telegraph Company.

Demand for Flexible Couplings.—Mr. R. H. Smith, of the Smith-Serell Company, general sales agent for the Francke Company, New Brunswick, N. J., manufacturer of flexible couplings, recently stated to a representative of the ELECTRICAL WORLD that more than 8000 couplings had been sold up to Feb. 1, 1915. The aggregate rating of the machines with which these couplings are used is more than 300,000 hp. The flexible coupling made by the above company is well adapted for use with all directly connected machines, it is declared, such as prime movers, motors and dynamos, blowers, compressors, gas exhausters, pumps, crushers, pulverizers, grinders, automobiles, elevators, mine hoists and rotary gas producers. The following are some of the power stations in which the flexible coupling is said to be used: The New York Edison Company, the Philadelphia Electric Company, the Cleveland Municipal Plant, the Milwaukee Electric Railway & Light Company, the Interborough Rapid Transit Company, New York; the Public Service Electric Company, Newark, N. J., and the Edison Electric Illuminating Company, Brooklyn, N. Y. It is also being used by the following manufacturers: The General Electric Company, the Westinghouse Electric & Manufacturing Company, the Allis-Chalmers Manufacturing Company, the Crocker-Wheeler Company, the American Blower Company and the B. F. Sturtevant Company.

Boston Automobile Show.—The thirteenth annual automobile show at Boston, Mass., opened March 6 in the Mechanics' Building, to last one week. Among the new exhibits was a 1.5-ton electric truck for contractors' service, built by the Andover Motor Vehicle Company, Andover, Mass. This equipment, which was shown for the first time, is noteworthy through the design of the battery-box supports. The battery is subdivided into four sections, each box being hinged to swing outward from the chassis frame to facilitate inspection and removal of cells, a locking spring holding the boxes in place when the truck is in operation. The truck is equipped with a General Electric motor, worm drive, Timkin bearings and solid tires, the battery boxes being carried 6 in. above the axles. The control is of the left-side type, and the driver occupies a low-hung cab with a front door and floor only about 18 in. above the street surface, greatly facilitating entrance and exit. Battery equipment is optional, and the battery boxes are hung between the forward and rear wheels in a symmetrical arrangement contributing to stability. Other exhibitors of electric pleasure cars or trucks at the show were the Ander-

son Electric Car Company, the Rauch & Lang Carriage Company, the Milburn Wagon Company, the General Vehicle Company, Inc., and the Waverley Company. Among the accessory exhibitors were the General Electric Company, the American Storage Battery Company, Cambridge, Mass.; S. F. Bowser & Company, Inc., Boston; the Disco Electric Starter Company, Detroit, Mich.; the Forest City Electric Company, and the Kemco Electric Manufacturing Company, Cleveland, Ohio.

Order for Ampere-Hour Meters.—The Sangamo Electric Company, Springfield, Ill., has just closed a contract with the Pullman Car Company for several thousand ampere-hour meters. This is the second large contract for this type of meter given the Sangamo company by the Pullman company. The meters are being used on the sleeping and parlor cars owned by the Pullman company to control the charging of the battery. The method of control employed has been devised by Ernst Lunn, chief electrician of the Pullman company.

New Electrical Manufacturing Firm Incorporated.—The Jefferson Electric Manufacturing Company, 847-851 West Harrison Street, Chicago, has been incorporated and has begun the manufacture of high-voltage and low-voltage transformers for bell ringing, toy operation, engine ignition, wireless, X-ray and welding work. The officers of the company are: Mr. J. A. Bennan, president and general manager; Mr. A. R. Johnson, secretary and sales manager, and Mr. J. C. Daley, treasurer. Each of the officers named formerly held a responsible position with the Thordarson Electric Manufacturing Company of Chicago.

Westinghouse Agent-Jobbers' Convention.—The Westinghouse agent-jobbers' spring meeting will be held at the Hotel LaSalle, Chicago, March 15 and 16, on the two days preceding the convention of the Electrical Supply Jobbers' Association. About fifty Westinghouse representatives and agents from all parts of the United States are expected to attend. On Monday evening there will be a banquet at which Mr. T. Julian McGill, manager of the Chicago office of the company, will preside as toastmaster. Mr. N. G. Harvey, general manager of the Illinois Electric Company, Chicago, is president of the Westinghouse agent-jobbers' association.

The D. & M. Lamp & Lighting Company, 13 Astor Place, New York, which was recently formed, has installed a lighting equipment, consisting of only four 350-watt nitrogen-filled lamps in a 7200-sq.-ft. hall for the school of the Church of the Holy Innocents, Brooklyn, N. Y. The ceiling of the hall is 42 ft. high and the hall seats 1200 persons. The lamps are equipped with special shades manufactured by the Laco-Philips Company, Lindhoven, Holland. The D. & M. Company exhibited various types of nitrogen-filled lamps at the recent automobile show in Brooklyn, including several special lamps for automobiles. George L. Deverell is president of the D. & M. Lamp & Lighting Company; Archibald J. McKinny, vice-president, and Alexander McKinny, Jr., secretary and treasurer.

Electric Automobile Starter Concern Prosperous.—The gross sales of Gray & Davis, Cambridge, Mass., manufacturers of electric starting apparatus and lighting equipment for automobiles, totaled about $4,000,000 in 1914, representing a new high-water mark in the income of the firm. The Cambridge factory is running full time and the smaller plant at Amesbury, Mass., is running day and night. About 100 orders a day are now coming in for electric starters suitable for Ford cars. The net earnings for 1914 amounted to about six times the preferred stock dividend. During the year the capital stock of the company increased from $500,000 to $750,000. The company has recently begun to manufacture electric motors according to its own designs, having formerly purchased these at an outlay of about $1,500,000 per year.

Orders for Stokers.—The Combustion Engineering Corporation, 11 Broadway, New York, is meeting with considerable success with its underfeed stokers, which are being used in a number of large plants. Its type E stoker is of improved design. With this stoker the coal is fed by hand or coal-conveying machinery into a large hopper and is carried under the fire by means of a reciprocating sliding bottom of a feed trough or retort which runs the full length of the stoker. The coal is delivered uniformly from the front to the rear by auxiliary pushers, and as it rises in the trough is distributed to the sides of the furnace by moving bars. The burning fuel is constantly carried by the action of the bars to the dumping trays along each side wall where the resulting ash or clinker is deposited. The following are some of the equipments that have been installed: The Philadelphia Electric Company, Philadelphia, at its Beacon Light plant, Chester, Pa., five stokers under 500-hp boilers; Kirkman & Son, Brooklyn, N. Y., five stokers under 400-hp boilers; Niagara, Lockport & Ontario Power Company, Buffalo, N. Y., four stokers under 360-hp boilers in standby plant (four units to be added in near future); the Flatbush Hygeia Ice Company, Brooklyn, N. Y., three stokers; the New York Steam Company, New York, two stokers under 600-hp boilers (six units to be added in the near future); the Southern Manual Training School, Philadelphia, Pa., four stokers under 250-hp boilers; the Grand Trunk Railway System, two stokers in one of its plants at Chicago; the Wheeling Traction Company, Wheeling, W. Va., ten stokers; the West Penn Traction Company, Pittsburgh, Pa., eleven stokers.

Electrically Operated Compressors.—According to the Blaisdell Machinery Company, Bradford, Pa., electrically driven compressors are being used with increasing frequency each year and are, to a considerable extent, superseding the steam-operated machines. The compressors made by the above company range from a small 2-ft. motor-driven garage pump to units with ratings of 5000 cu. ft. a minute. A large installation of the Blaisdell equipment is in the Peterborough plant of the Canadian General Electric Company. There are also ten large motor-driven machines operating on various kinds of tunnel work on the Canadian Northern Railway and the Canadian Pacific Railway. They are also being used in the shops of the Canadian Pacific Railway at Calgary. Besides the air compressors, the Blaisdell Machinery Company is making various types of large-sized electrically operated vacuum cleaners. One of the most notable recent installations is that made in the San Francisco hospital, which consists of eight motor-driven units. A reciprocating vacuum pump has also just been installed in the Widener residence, Elkins Park, Philadelphia, Pa. The Blaisdell vacuum cleaning systems are being used in the University Hospital, Augusta, Ga.; the Consumptive Hospital, Boston, Mass.; the Higgins Memorial Hospital, Olean, N. Y.; the Providence Hospital, Seattle, Wash.; the United States Naval Hospitals at Portsmouth, N. H., Newport, R. I., and Chelsea, Mass.; the Palace Theater, New York; the Church of the Assumption, Syracuse, N. Y.; the Cathedral of St. John the Divine, New York; the United States post offices at Cleveland, New Orleans, Kansas City and New York; the National Museum, Washington; the Congressional Library, Washington, and the United States Agricultural Building, Washington. The system is also being used in a number of schools, club houses, hotels, office buildings, banks, apartment houses and residences.

NEW YORK METAL MARKET PRICES

	March 2 — Selling Prices Bid	Asked	March 9 — Selling Prices Bid	Asked
Copper	£ s d		£ s d	
London, standard spot*	64 2 6		64 7 6	
Prime Lake	14.62½	to 14.75	.....	to 14.80
Electrolytic	14.50	to 14.60	.....	to 14.65
Casting	14.00	to 14.25	.....	to 14.25
Copper wire base	15.87½		15.87½	
Lead	3.90		3.95	
Nickel	42.00	to 45.00	42.00	to 45.00
Sheet zinc, f.o.b. smelter	13.00		13.50	
Spelter	10.75†		11.00†	
Straits tin	40.50		48.50†	
Aluminum, 98 to 99 per cent.	19.00	to 19.25	19.00	to 19.25

*OLD METALS

Heavy copper and wire	13.00	13.00
Brass, heavy	9.00	9.00
Brass, light	7.75	7.75
Lead, heavy	3.60	3.65
Zinc, scrap	7.37½	8.00

COPPER EXPORTS

Exports of copper in form of pigs, ingots, bars, plates and scrap for week ended Feb. 27, 1915 ..... 10,171,846 lb.

*From daily transactions on the New York Metal Exchange.
†Nominal.

New Incorporations

The City Light & Water Company, of Waverly, Tenn., has been incorporated with a capital stock of $4,000 by H. W. Hooper, J. D. Luten, J. F. Daniels and others. The company proposes to generate and distribute electricity for lamps and motors and operate water-works system.

The New Sewickley Light Company, of New Sewickley, Pa., has been chartered with a capital stock of $5,000 to operate in the township of New Sewickley. The incorporators are A. W. Stevenson, A. W. Robertson, J. R. McNary, L. F. Kane and E. W. Washbaugh, of Pittsburgh, Pa.

The Fort Loraine Light & Power Company, of Fort Loraine, Ohio, has been incorporated with a capital stock of $10,000 to construct and operate an electric-light and power plant in Fort Loraine. The incorporators are W. J. Sherman, Francis M. Sherman, B. T. Bull, H. E. Bennett and John Oldham.

New Industrial Companies

The Projectophone Company, of New York, N. Y., has been incorporated with a capital stock of $10,000 by Arthur H. Wing, Harry C. Wing and Frank H. Gerrodette. Wing & Wing, 27 Cedar Street, New York, are attorneys.

McLeod, Ward & Company, of New York, N. Y., has been incorporated by E. Holloway, H. D. Demarest and W. D. Bass, of Park Ridge, N. J. The company is capitalized at $15,000, and proposes to deal in electrical supplies, lamps, etc.

The Bethlehem Lamp Manufacturing Company, of South Bethlehem, Pa., has been incorporated with a capital stock of $10,000 to manufacture lighting apparatus. The incorporators are H. and D. Freiberger and S. Wiesenberger, of South Bethlehem, Pa.

The Mignon Wireless Corporation, of Elmira, N. Y., has been chartered with a capital stock of $5,000 to manufacture and deal in wireless instruments and apparatus for wireless messages. The incorporators are J. G. Gerhart, C. A. Mieth and E. C. Mignon, of Elmira.

Bauman & Loeb, of Brooklyn, N. Y., have filed articles of incorporation with a capital stock of $10,000 to manufacture and deal in gas and electric fixtures and appliances. The incorporators are J. Hill-Quit, W. Loeb and O. Bauman, 181 Penn Street, Brooklyn, N. Y.

The White Coal Company, of New York, N. Y., has been chartered with a capital stock of $10,000 to deal in coal, building, heating, lighting, ventilating and other materials. The incorporators are Walter M. Sundheimer, Thomas J. Bannon and Matthew J. White, 1494 University Avenue, the Bronx, New York, N. Y.

The Dur-Eco Electric Company, of New York, N. Y., has been incorporated with a capital stock of $100,000 to manufacture and deal in electric cooking, deodorizing and fumigating devices and engineers' supplies. The incorporators are H. Preston Coursen, Walter G. Merritt and Scott McLanahan, 135 Broadway, New York, N. Y.

The Franklin Bus Company has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $25,000 for the purpose of conducting buses operated by electricity or other power. The incorporators are L. C. Hartman, J. H. Kresge, of West Pittston, Pa., and J. E. Turnbull, of Wilkes-Barre, Pa.

The Union Engineers of New York, of New York, N. Y., have filed articles of incorporation with a capital stock of $12,000 for the purpose of doing a general construction, heating, ventilating and electrical-contracting business. The incorporators are William E. McKeen, Frank L. Clark, 125 East Twenty-third Street, New York, N. Y., and others.

The Electrical Institute of New York has filed articles of incorporation with the Secretary of State, with a capital stock of $5,000, for the purpose of dealing in mechanical and electrical-chemical appliances, machinery, apparatus, etc. The incorporators are Sideny H. Loeb, J. J. Popper and F. Hauser, 59 West 109th Street, New York, N. Y.

Trade Publications

Electric Hoists.—The Link-Belt Company, Chicago, Ill., has recently published Bulletin No. 207, which describes a recently developed electric hoist.

Flashlamp.—The Beacon Miniature Electric Company, 118 Duane Street, New York, has prepared a leaflet which describes its fountain-pen flashlamp.

Books on Electricity.—Frederick J. Drake & Company, Chicago, Ill., are sending out a leaflet which describes several of their 1915 books on electricity.

Outdoor Metering Outfit.—Bulletin No. 46,251, issued by the General Electric Company, Schenectady, N. Y., describes its outdoor metering outfit for 11,000 volts..

Nitrogen-Filled Lamps.—Nitrogen-filled lamps rated at 100 watts and 200 watts are described in a leaflet issued by the Lux Manufacturing Company, Hoboken, N. J.

Small Hydraulic Plants.—"Electric Light Plants Driven by Small Water-Powers" is the subject of Bulletin No. 16 issued by the Fitz Water Wheel Company, Hanover, Pa.

Steam Purifier.—The Tracy Engineering Company, San Francisco, Cal., has recently issued its Catalog No. 10, which describes and illustrates its steam-purifying apparatus.

Automobile Bell.—The Trinity Bell Electrical Manufacturing Company, 5018 Calumet Avenue, Chicago, Ill., has prepared a folder which describes its electrically operated automobile bell.

Wheel-Lathe Equipment.—Leaflet No. 3482-A, just issued by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., contains information on electrical apparatus for wheel lathes.

Electric Fans.—A booklet recently issued by the Robbins & Myers Company, Springfield, Ohio, contains information on its electrically operated fans and an article entitled "Keeping Cool," by Elbert Hubbard.

Steam-Turbine Drive for Rolling Mills.—The De Laval Steam Turbine Company, Trenton, N. J., has recently prepared an illustrated bulletin which describes its steam turbines designed for rolling-mill service.

Automatic Switch for Electrically Operated Pumps.—The Martin & Anson Company, 2226 Indiana Avenue, Chicago, Ill., has issued a leaflet which describes its inclosed automatic switch for air pumps and water pumps.

Ornamental Lamp-Posts.—The Chicago Concrete Post Company, 608 South Dearborn Street, Chicago, has issued a booklet describing and illustrating actual installations of its "Star" ornamental street-lighting standards.

Steel Pipes.—Bulletin No. 24 issued by the National Tube Company, Pittsburgh, Pa., contains reprints from the *Iron Age*, the *Iron Trade Review* and the *American Metal Market and Daily Iron and Steel Report* on the development of steel pipe.

Switching Apparatus for Automobiles.—Bulletin No. 12, published by the Hartman Electrical Manufacturing Company, Mansfield, Ohio, describes and illustrates automatic lighting switches, current indicators, starter switches, etc., for automobiles.

Flashlamps.—The American Ever Ready Works of the National Carbon Company, 308 Hudson Street, New York, are sending out a large-sized bulletin which contains illustrations of a number of their advertisements printed in various magazines and of applications of their lamps to various purposes.

Flexible Couplings.—The Smith-Serrell Company, 90 West Street, New York, general sales agent for the Francke Company, New Brunswick, N. J., is sending out Bulletin No. 18 and several folders and cards which describe and illustrate various types of flexible couplings for directly connected machines.

Electrical Problems.—The Westinghouse Electric & Manufacturing Company is sending out a reprint of a paper entitled "Some Electrical Problems Practically Considered," which was read before the recent convention of the Iron and Steel Electrical Engineers at Cleveland by Mr. B. G. Lamme, chief engineer of the company.

Construction News

New England

RUMFORD FALLS, MAINE.—The Rumford Falls Pwr. Co., of Rumford, is now changing the waterwheels to increase the output of its plant to 3000 hp. Charles A. Mixer is engineer.

MILTON, N. H.—Application has been made to the Public Service Commission by John B. Giguerre for permission to install and operate an electric light and power plant in Milton.

CONCORD, MASS.—Within the next six months the electric-light commission expects to purchase about 100 meters and some transformers and material for about 1 mile of new line and some material for repairs, etc.; also some electrical appliances, including heating and cooking apparatus, vacuum cleaners, washing machines, etc., as ordered. Albert W. Lee is manager.

Middle Atlantic

BROOKLYN, N. Y.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until March 23 for delivering at the navy yard, Brooklyn, N. Y., supplies as follows: Brass and steel bolts and nuts, sheet brass, burlap, buzzers, interior communication and telephone cable, arc-lamp carbons, shipping cases, electrolytic cells, brass conduit, air-port glasses, bull's-eye lanterns, searchlamp mirrors, lead pipe, sal ammoniac, steel powder tanks, safety treads, brass tubing, and electrical wire. Applications for proposals should be made to the navy pay office, New York, N. Y., or to the above office. Samuel McGowan is paymaster-general, U. S. N.

KINGS PARK, N. Y.—Bids will be received by the State Hospital Commission, Capitol, Albany, until March 18, for construction, including heating, plumbing and electric work, for additional accommodations for chronic patients at the Kings Park State Hospital, Kings Park. Drawings and specifications and blank forms of proposals may be obtained at the Department of Architecture, Capitol, Albany. Drawings and specifications may be consulted at Kings Park State Hospital, Kings Park, and at the New York office of the Department of Architecture, Room 1224, Woolworth Building, and at the Department of Architecture, Capitol, Albany.

MALONE, N. Y.—Within the next six months the Malone Lt. & Pwr. Co. expects to purchase material for extension of lines into rural districts around Malone. The company also expects to install a street-lighting system (using incandescent lamps) in the village of Bangor. S. G. Hunter is superintendent.

NEW YORK, N. Y.—Bids will be received by F. J. H. Kracke, commissioner of bridges, Municipal Building, New York, N. Y., until March 18 for constructing an additional elevator in the north tower of the Queens anchor pier of the Queensboro Bridge. Blank forms and specifications may be obtained at the office of the Department of Bridges, Municipal Building, New York.

NEW YORK, N. Y.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until March 25 for the construction (including metal shelving equipment, interior lighting fixtures and electric conduit and wiring) of an interior safety vault for the United States Appraisers' Warehouse at New York, N. Y. Drawings and specifications may be obtained from the above office.

NEW YORK, N. Y.—Bids will be received by the board of trustees of Bellevue and Allied Hospitals, Bellevue Hospital, 415 East Twenty-sixth Street, New York, until March 19, for furnishing general plant materials, including engineers' materials and electricians' supplies, etc., under Specification No. 10. Blank forms and further information may be obtained at the office of the contract clerk and auditor, No. 400 East Twenty-ninth Street, New York.

NEW YORK, N. Y.—Bids will be received by the Board of Health, Department of Health, corner of Centre and Walker Streets, New York, until March 22 for furnishing material and labor necessary to install and complete, together with all necessary alterations and other work incidental thereto, the electric circuit work of pavilions Nos. 8 and 9 on the grounds of the Department of Health, North Brother Island, borough of the Bronx, New York City. Plans may be seen and blank forms for the above work and further information may be obtained at the above office.

WATERVLIET, N. Y.—Bids will be received by the Board of Contract and Supply, 1520 Broadway, Watervliet, until March 22 for the construction of a city hall. Bids will be received for the complete work or on any part. Plans and specifications are on file at the above office and also at the office of Demers, Mosley & Campaigne, architects, Ilium Building, Troy, N. Y.

WEEDSPORT, N. Y.—The Public Service Commission has handed down a decision holding the election held in this village last November, at which the proposal to establish a municipal electric-light plant was carried, to be legal.

ALTOONA, PA.—The Penn Central Lt. & Pwr. Co., of Altoona, it is reported, is contemplating extensions to its lines in territory already occupied, involving an expenditure of about $100,000. The company is also planning to extend its transmission lines in new territory. The proposed plans also provide for increasing the output of the generating plant at Williamsburg.

CEMENTON, PA.—Application has been made to the Public Service Commission by the Cementon El. Lt. & Pwr. Co. for approval of the sale and assignment of all its franchises and property to the Lehigh Valley Lt. & Pwr. Co., Allentown.

GETTYSBURG, PA.—Preparations, it is reported, are being made by the Gettysburg Lt. Co. to change its system from a single-phase, two-wire circuit to a three-phase, three-wire circuit.

HARRISBURG, PA.—Contracts have recently been approved by the Public Service Commission as follows: The Lily Lt., Ht. & Pwr. Co. and the borough of Lily, which calls for street-lighting; the West Penn El. Co. and the city of Connellsville, for furnishing electricity for street-lighting; the Sykesville El. Lt., Ht. & Pwr. Co. and the borough of Sykesville, for street-lighting service and for electricity for other purposes in the borough.

LEHIGHTON, PA.—Plans are being considered by the Lehighton El. Lt. & Pwr. Co. for replacing its water-tube system and overhauling its main bank of Stirling boilers, including the rebuilding of arches and brickwork and remodeling stack base. It also proposes to make general repairs on its lines, changing some of the series incandescent lamp circuits to arc circuits, etc.

NEW SEWICKLEY, PA. (not a post office).—The New Sewickley Lt. Co., recently granted a charter, proposes to install and operate an electric-lighting system in New Sewickley. The company is capitalized at $5,000, and the incorporators are A. W. Stevenson, A. W. Robertson, J. R. McNary, L. F. Kane and E. W. Washbaugh, of Pittsburgh.

NORRISTOWN, PA.—The electric light commission expects to purchase 100 series tungsten lamps of 100 cp for the municipal street-lighting system. William G. Risdon is superintendent.

PHILADELPHIA, PA.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until March 29 for coal-handling apparatus, etc., in the United States Mint at Philadelphia, Pa., in accordance with drawings and specifications, copies of which may be obtained at the above office or the office of the custodian of the United States Mint, Philadelphia.

RIDGWAY, PA.—The Ridgway El. Lt. Co. is reported to be contemplating changing its motive power to steam. At present gas engines are used. The company also proposes to erect a high-tension transmission line from Ridgway to Johnsonburg and Kane.

TITUSVILLE, PA.—The city of Titusville is contemplating installing an alternating-current generator in the municipal electric-lighting plant and replacing the present arc lamps with incandescent lamps. H. A. Holstein is manager.

HADDONFIELD, N. J.—The commissioners of Haddonfield have decided to place additional electric lamps on Linden, Elm and Woodland Avenues. The street-lighting service is furnished by the Pub. Ser. El. Co., of Newark.

PARKERSBURG, W. VA.—Within the next 12 months the Parkersburg, Marietta & Interurban Ry. Co., of Parkersburg, expects to install a 9000-kw steam turbine complete; 5000 kw already installed, the rest to be added later. C. G. Gallaher is acting manager.

WHEELING, W. VA.—The Wheeling El. Co. is contemplating extending its high-tension line from Glencoe to Barnesville, a distance of 20 miles; also will erect a high-tension line from Wheeling to Moundsville, 10 miles distant, and complete a high-tension line from Rayland, Ohio, to Steubenville, Ohio. Numerous other short extensions will also be made. J. B. Gardner is general manager.

WASHINGTON, D. C.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until March 27 for a 15-ton, four-motor electric traveling crane, delivered and erected at the navy yard, Washington. Plans and specifications may be obtained on application to the above bureau or to the commandant of the navy yard named. H. R. Stanford is chief of bureau.

WASHINGTON, D. C.—Bids will be received at the office of the Commissioners of the District of Columbia, 509 District Building, Washington, until March 15, for furnishing and delivering, f.o.b. Washington, one switchboard and accessories for use in the Sewer Department. Plans and specifications may be obtained from the purchasing officer, Room 320, District Building, Washington, D. C.

WASHINGTON, D. C.—Foreign trade opportunities, as announced by the Bureau of Foreign and Domestic Commerce in the Commerce Reports, are as follows: No. 15,824—An American consul in Europe reports that an agent in his district desires immediate quotations, f.o.b. steamer, on telephone and telegraph wire. It is stated that the government is preparing to expend $134,000 on this commodity. Correspondence may be in English. No. 15,826—An American consular officer in one of the neutral European countries reports that a business man in his district desires American manufacturers and exporters to quote at once, prices f.o.b. New York, on searchlamps for field service and fortifications, in all sizes. Correspondence may be in English. No. 15,844—An American consul in Africa reports that a man in his district wishes to secure an agency for the sale of an electrical device for felling trees. No. 15,846—One of the foreign embassies in Washington, D. C., has informed this bureau that it is in receipt of inquiries for cable quotations on quantities of regenerated dioxide of manganese for electric cells. No. 15,850—An American consular officer in South America reports that a firm in his district which operates gas and electric-light plants is desirous of communicating with American dealers and manufacturers of gas and electric fixtures, electrical apparatus, including stoves, and toys, supplies and machinery. Catalogs and correspondence may be in English, but Spanish is preferred. No. 15,868—An American consular officer in Africa has transmitted plans, specifications, etc., relative to an opportunity for American firms to bid on supplying seven 5-ton and one 10-ton electrically operated cranes for a port in his district. Bids will be open about April 30. Plans may be seen at the above bureau and its branches. No. 15,872—The commercial agent of the Bureau of Foreign and Domestic Commerce in New York City reports that there seems to be an opportunity for American manufacturers of electrotyping and photo-lithographing machinery to secure an order from one of the Latin-American governments. Further information may be obtained from the Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., or its branches.

North Central

COPEMISH, MICH.—A committee consisting of A. L. Gleason and others has been appointed by the Village Council to make investigations in regard to establishing a municipal electric-lighting plant in Copemish.

CROSWELL, MICH.—The City Council, it is reported, has engaged J. Stark, of Detroit, to supervise the installation of additional equipment in the municipal electric-light plant. When improvements are completed a 24-hour service will be established.

DETROIT, MICH.—Bids will be received by Charles A. Gadd, secretary of board of education, Detroit, until March 23 for the construction complete of the Garfield School and the Southeastern High School in Detroit.

LANSING, MICH.—Extensions and improvements, it is reported, are contemplated by the Michigan Pwr. Co., involving an expenditure of about $30,000, of which $10,000 will be expended on the power station and the remainder on the distributing system in Lansing and vicinity. D. R. Thomas is manager.

MUNISING, MICH.—The Electric Lt. & Pwr. Co., of Munising, has recently erected a 45-ft. by 157-ft. brick power station and installed one 250-kw, three-phase generating unit complete, and expects to install an additional generating unit of the same rating within the next few months. James Hosking is vice-president and general manager.

MUSKEGON, MICH.—The Grand Rapids-Muskegon Pwr. Co. has nearly completed the rebuilding of all its lines in the Muskegon territory and this year has in view a number of small lighting line extensions, to cover its scattered residential lighting districts. The company has had inquiries to extend its service to Lake Harbor (a summer hotel district on Lake Michigan), about 4 miles from Muskegon, and also to North Muskegon, which is about 4 miles distant; both propositions will cover lighting and small motor service. While nothing definite has been decided upon, estimates are being made to see whether sufficient business can be obtained to warrant the expenditure. The company has also had a request from the city of Whitehall to submit a proposal to supply service there, but nothing definite has been decided upon. W. M. Lewis is local manager.

NILES, MICH.—The Board of Public Works expects to purchase a small amount of line material and some poles for repairs to present equipment. F. S. Hadfield is superintendent.

SOUTH BOARDMAN, MICH. — The Boardman Lt. Co., successor to the Blackmon Lt. Co., is contemplating making some additions and improvements this season, but as yet plans have not been decided upon. Charles L. Sessions is proprietor and manager.

UNION CITY, MICH.—Within the next 12 months the light and water commissioners expect to purchase a 1500-gal. pump (direct pressure) for the water-works system. F. O. Webber is superintendent.

CLEVELAND, OHIO.—Bids will be received at the office of A. R. Callow, commissioner of purchases and supplies, Room 511, City Hall, Cleveland, until March 19 for fiber conduit for the municipal electric-light department. Specifications may be obtained at the office of the commissioner of light and heat division, 1443 East Third Street.

CLEVELAND, OHIO.—Bids will be received at the office of A. R. Callow, commissioner of purchases and supplies, Room 511, City Hall, Cleveland, until March 19, for electric wiring of power house and tunnels at city hospital. Specifications may be obtained at the office of the city architect, Room 420, City Hall, upon deposit of $5, which will be refunded upon return of same.

COSHOCTON, OHIO—The Ohio Ser. Co., of Coshocton, expects to complete its 33,000-volt transmission system this year, which will connect Strasburg, Canal Dover, New Philadelphia, Midvale, Dennison, Uhrichsville, Newcomerstown, West Lafayette, Coshocton, Cambridge and Byesville. The company also contemplates the erection of a 13,000-volt transmission line to Tippecanoe, Ohio, 9 miles long, work on which will soon begin.

FINDLAY, OHIO.—The Toledo, Bowling Green & Southern Trac. Co., having been granted an extension of 25 years to its franchise in Findlay, has announced that the electric plant will be enlarged and that much of its railway track in the city will be repaired and renewed. Charles F. Smith is general manager.

GOMER, OHIO.—The Village Council is negotiating with the Ohio El. Ry. Co. to extend its lines to Gomer to furnish electrical service here.

MIDDLETOWN, OHIO.—Bids will be received by the City Commission of Middletown until March 30 for lighting the streets, alleys, buildings and other public places within the city for a period of ten years from April 27, 1915; also for the installation of an ornamental lighting system in accordance with specifications approved and adopted by the commissioners. Separate bids are to be submitted on ornamental system. John Kunz is city clerk.

NORWALK, OHIO.—By the decision handed down by the Court of Appeals on Feb. 27 the temporary injunction secured by the Cleveland, Southwestern & Columbus Ry. Co. to prevent the city of Norwalk from disposing of a bond issue of $100,000 was dissolved, and the city is allowed to proceed with the sale of the bonds.

SANDUSKY, OHIO.—The City Council is considering plans for the construction of an underground-conduit system to accommodate not only its fire-alarm and police-call systems, but wires of the telephone and telegraph companies.

SHAWNEE, OHIO.—Within the next two months the Ohio Lt. & Pwr. Co., of Shawnee, expects to erect substations in Shawnee and Straitsville for the purpose of distributing electricity received from the Newark plant. When completed the local plant will be closed down. The company also expects to erect a transmission line from Shawnee to New Lexington, a distance of 10 miles, within the next few months. It has recently completed a line from Sharon to Logan, 15 miles long. L. W. Laube is superintendent.

SPENCERVILLE, OHIO.—The town of Spencerville expects to purchase within the next three months two boilers, one steam engine and generator for the municipal electric-light plant. Charles S. Fryer is clerk.

SPRINGFIELD, OHIO—Plans are being prepared by the Springfield Lt., Ht. & Pwr. Co. for extensions and repairs to its system, involving an expenditure of about $60,000. W. Parsons is general manager.

WAUSEON, OHIO.—Petitions have been put in circulation asking that an election be held to submit the proposal to establish a municipal electric-lighting plant in Wauseon to the voters.

YOUNGSTOWN, OHIO.—Plans are being considered by Messrs. Pfau & Faunce for the construction of a large garage in Youngstown, to cost about $50,000, complete, with machine-shop equipment and electrically operated machinery.

LEWISBURG, KY.—V. L. Price, owner of the Lewisburg planing mill, has begun work on the construction of an electric-lighting plant to be operated in conjunction with the mill.

LUDLOW, KY.—Bids will be received by W. B. Cullen, city clerk, Ludlow, until March 18 for a franchise to install and operate a telephone system in the city of Ludlow for a period of 20 years.

NEW HAVEN, KY.—The contract for equipment for the municipal electric-light plant has been awarded to Fairbanks, Morse & Co., of Louisville. Charles R. Heizer is engineer in charge.

FORT WAYNE, IND.—Arrangements are being made by the city of Fort Wayne to erect an arc-lamp belt circuit this summer to encompass the entire city to relieve some of the overload circuits now in use and to make it possible to give street-lighting service in portions of the city not reached at present.

GOSHEN, IND.—The Hawkes El. Co., of Goshen, is contemplating the erection of a 6600-volt transmission line to Middlebury, a distance of 10 miles, to furnish electrical service there. The street-lighting system will consist of 40 6.6-amp lamps.

HAMMOND, IND.—Bids will be received by the Board of Public Works, City Hall, Hammond, until March 17 for the construction of bath house complete, including plumbing, steamfitting, electric wiring, lighting fixtures, lamps and clothes drier, to be situated at Lake Front Park. Plans and specifications can be seen at the office of the Board of Public Works, Hammond, or at the office of the architects, J. T. Hutton & Son, 314 Hammond Building, Hammond.

JEFFERSONVILLE, IND.—Plans have been approved by the City Council for substituting incandescent nitrogen lamps for the arc lamps now in use. The specifications call for 128 lamps of 80 cp, 138 of 250 cp and 15 400-cp lamps.

VINCENNES, IND.—Plans are being considered by the City El. Ltg. Co. of Vincennes for the installation of an ornamental lighting system on Main Street, between Seventh and First Streets, to cost about $3,000. The plans provide for 60 posts for five-lamp clusters (60 100-watt and 240 60-watt Mazda lamps), to be maintained by underground wires. The system will probably not be installed until next summer. Felix L. Cadou is manager.

CISSNA PARK, ILL.—Within the next eight months the El. Ser. Co., of Cissna Park, expects to erect a transmission line to a small village about 4 miles distant; also a number of short lines, amounting to not more than 2 miles, to furnish electrical service to farmers. The company will need about 2500 lb. of Nos. 8, 10 and 12 wire and is also looking for a general supply of lamps. E. Lindnir is manager.

MIDDLETOWN, ILL.—A special election will be called to submit the proposal to issue $4,000 in bonds for the installation of a municipal electric-lighting system. The present plans provide for making a connection with the transmission line of the New Holland El. Lt. Co., of New Holland.

SPRING VALLEY, ILL.—The Spring Valley Utilities Co. contemplates the erection of about 20 miles of 33,000-volt transmission lines and about 25 miles of 6600-volt transmission lines and also distributing systems in two small towns. R. W. Brown is manager.

JANESVILLE, WIS.—Plans are being prepared by D. C. & William B. Jackson, consulting engineers, Harris Trust Building, Chicago, Ill., for rebuilding the Janesville El. Co. plant, recently destroyed by fire. P. H. Korst is president.

WYOCENA, WIS.—Bids will be received at the office of the county clerk of Columbia County, Court House, Portage, until March 23 for construction of a new poor house, including electric wiring and electric fixtures, and a central heating plant on the farm of the Asylum for Chronic Insane at Wyocena. Plans and specifications are on file at the office of the county clerk, Portage, and at the office of Allan D. Conover, architect, 36 Tenney Block, Madison, Wis.

BOVEY, MINN.—Within the next three months the Western Mesabe El. Co., of Bovey, expects to purchase three 33,000/2300-volt, three-phase transformers, three 2300/220-volt transformers, 250 poles, insulators, wire, meters, etc. William H. Mackie is manager.

MANKATO, MINN.—Within the next three months the Consumers' Pwr. Co., of Mankato, expects to erect 35 miles of transmission lines to several towns around Mankato. R. E. Brown is general manager.

MAPLE LAKE, MINN.—The City Council has passed an ordinance granting the Pub. Ser. Co., of St. Cloud, a franchise to construct and operate an electric-lighting system in Maple Lake.

MILACA, MINN.—Repairs will be made to the engine and settings of the municipal electric-light plant within the next two months. No new equipment will be required. J. A. Kaliher is superintendent.

MILAN, MINN.—The contract for the construction of an electric-light plant for Hougland & Kanton has been awarded to A. J. Kaufman, of Appleton, Minn.

PARK RAPIDS, MINN.—L. H. Rice, owner of the local electric-light and power plant, expects to purchase within the next 12 months ornamental lamp-posts and underground cable for ornamental lighting system.

PIPESTONE, MINN.—The Northwest Lt. & Pwr. Co., of Pipestone, expects to erect within the next 12 months 18 miles of transmission lines. Carl I. Oppen is manager.

ST. CLOUD, MINN.—Bids will be received by the State Board of Control, Capitol Building, St. Paul, until March 23 for structural steel and cast-iron work, steel sash and roofing and sheet-metal work required for power house for the State Reformatory, St. Cloud, in accordance with plans and specifications prepared by C. H. Johnston, architect, 715 Capital Bank Building, St. Paul.

SHERBURN, MINN.—The Board of Public Works expects to purchase a 220-volt, 25-amp, eight-hour battery for lighting 118 cells; also within the next six months to purchase equipment for an ornamental lighting system. G. Fabianke is manager.

ALTOONA, IA.—Within the next three months the Gibson El. Co., of Altoona, expects to purchase transformers, poles and other line material for the erection of several rural lines out of both Altoona and Mitchelville, and for considerable new line work in both of the above-named towns; also to purchase electrical appliances, including heating and cooking apparatus, vacuum cleaners, washing machines, etc. George T. Gibson is proprietor.

CAMERON, MO.—Bids will be received by Clarence Staples, city clerk, Cameron, Mo., until March 16 for furnishing and installing equipment for electric-light plant as follows: One 300-hp simple Corliss engine, non-condensing (for direct connection); one 250-kva, three-phase, 60-cycle, 2300-volt generator (for direction connection), with belted exciter; one switchboard panel and instruments for generator and exciter; also additional switchboard instruments; furnishing and erecting new steel stack. Complete plans and specifications are on file with the city clerk, or may be seen at the office of Harper & Stiles, 914 Grand Avenue Temple, Kansas City, Mo., consulting engineers.

FAYETTE, MO.—The Fayette Lt., Ice & Coal Co. expects to purchase within the next two months a new smokestack. J. B. Bell is president and general manager.

MEADVILLE, MO.—The installation of a municipal electric-lighting system, including the erection of a 14-mile transmission line to Chillicothe, is under construction and material has been purchased. D. L. Strongquist, of Concordia, Kan., is engineer in charge.

MOUND CITY, MO.—The Mound City El. Lt. & Ice Co. expects to extend its transmission lines to Maitland and Graham in the near future. R. W. Neill is manager.

WHEELING, MO. — Preparations are being made by E. A. Lowe, of Meadville, for the installation of an electric-lighting plant in Wheeling, for which material has been purchased. Electricity for operating the system will probably be secured from the Meadville transmission line. D. L. Strongquist, of Concordia, Kan., is engineer in charge.

WILLISTON, N. D.—Within the next eight months the city of Williston expects to purchase two 500-kw steam turbines, with 2300-volt, 60-cycle generators and con-

densers for same, for the municipal electric-lighting plant; also to purchase within the next six months 300 ornamental lamp-posts. C. C. Mackenroth is superintendent.

HURLEY, S. D.—Within the next six months the Hurley Lt. Co. expects to purchase wiring supplies, heating and cooking devices, etc. H. E. Dunn is manager.

MADISON, S. D.—Bids will be received by the City Commissioners of Madison until March 29 for furnishing the following electrical equipment: One 50-hp slip-ring-type induction motor, one drum-type controller for above motor, two motor-control panels, one 50-hp and the other 40-hp; 125 linear ft. four-conductor, lead-covered cable and 125 linear ft. fiber conduit and fittings. Bids will also be received at the same time for furnishing and installing an engine of approximately 350 hp (bids will be received on both crude-oil and producer-gas engines), one two-phase, 60-cycle, 2200-volt generator, directly connected to engine; also exciter and three switchboard panels with instruments. For details see proposal columns. Charles A. Trimmer, of Madison, is consulting engineer.

STAMFORD, NEB.—The City Council is reported to have granted a franchise to David Elder to construct and operate an electric-lighting system in Stamford for a period of 99 years.

BUCKLIN, KAN.—Plans are being considered for increasing the output of the municipal electric-light plant before fall. As yet nothing definite has been decided upon. C. E. Ward is superintendent.

CANEY, KAN.—Within the next 30 days the Caney El. Lt. & Ry. Co. expects to purchase one carload of poles (25-ft., 30-ft. and 35-ft.). J. C. Miller is manager.

CLAY CENTRE, KAN.—The Public Utilities Commission may purchase within the next two months oil-burning equipment for three boilers. C. F. Rasmussen is superintendent.

COTTONWOOD FALLS, KAN.—Within the next three months the Home Lt. & Pwr. Co., of Cottonwood Falls, expects to purchase one storage-battery car. W. W. Austin is manager.

DODGE CITY, KAN.—A theater, to cost about $90,000, will be erected here this summer by Messrs. Merritt and Otero Beeson, of Dodge City. The electrical features will be given special attention.

HERINGTON, KAN.—The city of Herington expects to install in the municipal electric-light plant a directly connected unit, consisting of a high-efficiency compound engine and a 250-kva, three-phase, 60-cycle, 2300-volt generator with exciter. E. J. Wolcott is superintendent.

INDEPENDENCE, KAN.—The Oil Belt Terminal R. R. Co., it is reported, is contemplating the construction of an electric power plant on Lagoon Creek between Oilton and Jennings, Okla. Frank Brown, of Independence, is president of the company.

LA CROSSE, KAN.—The municipal electric-light plant has been purchased by R. M. Wilson, of Eureka, Kan., who has been given a 20-year franchise to operate the same. A 10-ton ice factory will be installed and operated in connection with the electric plant. A company has been organized under the name of the La Crosse Ice & Lt. Co. R. M. Wilson is manager.

PHILLIPSBURG, KAN.—The Phillipsburg Mill & Elevator Co., it is reported, contemplates extending its electric-lighting system to Logan, Glade and Speed. Preliminary plans are being prepared for the installation of a 200-hp oil engine and other machinery.

PAOLA, KAN.—The People's El. Lt. Co., of Paola, expects to build a new power station this year and install two new 150-hp boilers, one 200-kw generator (directly connected), and one 75-kw generator, belt-driven. W. H. Moorehouse is president and manager.

Southern States

GIBSON, N. C.—The City Council is contemplating the installation of a municipal electric-lighting plant.

ST. PAUL'S, N. C.—Within the next 30 days the St. Paul's Lt. & Pwr. Co. expects to erect a pole line to the cotton mill and additional lines to other parts of the town; also to purchase some transformers. Opie Odum is secretary and treasurer.

BLACKVILLE, S. C.—Preparations are being made by the city of Blackville for improvements to the municipal electric-lighting plant, bids for which will be received until March 15. J. M. Farrell is chairman.

PERRY, GA.—Plans are being considered by W. L. Henry and others for the development of water-power at Tharpe's Mill and to erect a transmission line into Perry. The Council is reported to have awarded them a contract to light the city and to furnish energy to operate the pumping plant of the water-works system.

BRISTOL, TENN.-VA.—The entire output of the El. Trans. Co. of Lee County, Ky., has been purchased by the Stonega Coal & Coke Co., of Stonega, under a contract which provides that the transmission company shall increase the output of its plant to 12,000 hp. The plant of the company, which is in the Black Mountain fields, is driven by steam-power and its normal rating is about 2000 hp.

CLANTON, ALA.—The Council is reported to have granted Dr. J. P. Hayes and others a franchise to construct and operate an electric-lighting plant in Clanton.

TUPELO, MISS.—Within the next three months the city of Tupelo expects to purchase 40 ornamental lamp standards for five-lamp clusters, and underground lead-covered cable to extend the ornamental lighting system about five blocks. E. R. Chisholm is superintendent.

CABOT, ARK.—The Cabot Lt. & Pwr. Co., recently organized, proposes to construct and operate an electric-lighting plant in Cabot. M. Young is president.

GENTRY, ARK.—The installation of a municipal electric-lighting plant and water-works system is reported to be under consideration by the City Council.

HORATIO, ARK.—The installation of an electric-lighting plant in Horatio is reported to be under consideration.

MALVERN, ARK.—The Citizens' Lt. Co., recently organized with a capital stock of $20,000, it is reported, will soon apply for a franchise in Malvern. R. S. Brooks and Thomas Edwards are interested in the project.

MANDEVILLE, LA.—Preparations are being made by the St. Tammany & New Orleans Ry. & Ferry Co. to equip its railroad for electrical operation from Mandeville to Covington. Equipment, it is understood, has been purchased. Harold Raymond, Interstate Bank Building, New Orleans, is consulting engineer.

CORPUS CHRISTI, TEX.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until April 19 for the construction (including mechanical equipment, except elevator and approaches) of the United States post office, court house and custom house at Corpus Christi. Drawings and specifications may be obtained at the above office or from the custodian of site at Corpus Christi.

CUMBY, TEX.—The Cumby El. Lt. Co. is planning to rebuild its electric plant, recently destroyed by fire.

MALAKOFF, TEX.—A new electric plant has recently been installed in Malakoff by S. J. Hall.

ORANGE, TEX.—The Orange Ice, Lt & Wtr. Co. is contemplating the installation of a 150-kw generator and other equipment in its plant.

OZONA, TEX.—The Ozona Improvement Co. will soon rebuild its plant, discarding the present outfit entirely. New equipment will be installed, consisting of two 25-hp Fairbanks-Morse (type Y) oil engines, two 20-kva, three-phase, 60-cycle, 2300-volt generators, double-panel switchboard, etc., at a cost of about $4,500. Frank F. Friend is manager.

ROXTON, TEX.—The Texas Pwr. & Lt. Co., of Dallas, is contemplating installing an electric-light system in Roxton.

Pacific States

ARLINGTON, WASH.—The Kellogg-Marsh Grange has petitioned the Jim Creek Wtr., Lt. & Pwr. Co., of Arlington, to extend its transmission lines to the Marsh District to furnish electrical service there.

PENDLETON, ORE.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until March 25 for construction complete (including mechanical equipment, except elevator, lighting fixtures and approaches) of the United States post office and court house at Pendleton. Drawings and specifications may be obtained at the above office or from the custodian of site at Pendleton.

ASHTON, IDAHO.—The Public Utilities Commission has granted N. M. Holm, of Shelly, and F. C. Bowman a certificate of public convenience giving them permission to construct and operate an electric power plant at Ashton and to erect transmission lines from the plant to the Mud Lake country and to Roberts. Energy will be utilized for pumping water to irrigate about 20,000 acres of land which it is proposed to develop.

MALAD CITY, IDAHO.—The Evans Lt. Co., of Malad City, is contemplating the erection of new transmission lines and extensions to present system and is considering rebuilding its distribution system and also the municipal lighting system. D. L. Evans, Jr., is manager.

PAYETTE, IDAHO.—The Idaho Pwr. & Lt Co., which has taken over the property of the Beaver River Pwr. Co., has announced that work will soon begin on the erection of an electric transmission line through the Payette Valley to accommodate the villages and farming communities in that district. The company holds franchises to supply electricity for lamps and motors in Emmett, New Plymouth, Fruitland and Payette. The company operates two plants, one at Malad and the other at Swan Falls.

MOAB, UTAH.—The City Council is negotiating with the local electric-light company for lighting the streets of the city. The company has recently completed its plant in Moab.

BILLINGS, MONT.—Bids will be received at the office of L. E. Torrence, city clerk, Billings, Mont., until March 17, for improvements on water-works system for which separate bids will be received as follows: (1) For furnishing material and constructing extensions to water-works system; (2) for material and construction of reinforced-concrete settling basin, concrete construction for filters, brick filter house, etc.; (3) for furnishing and erecting six 1,000,000-gal. mechanical filter units; (4) for furnishing and erecting a 1350-gal. turbine pump and a 100-hp motor. Plans and specifications are on file in the office of the city clerk, Billings, and at the office of Burns & McDonnell, Scarrett Building, Kansas City, Mo., consulting engineers.

DEER LODGE, MONT.—The City Council has adopted a resolution creating a special improvement district 32, in which an electric-lighting system will be installed, at a cost of about $6,000.

CHEYENNE, WYO.—The City Commissioners have passed an ordinance providing for an additional five-year extension of the contract with the Cheyenne Lt., Fuel & Pwr. Co. for lighting the streets of the city, in return for which the ordinance calls for a reduction in the price of electricity in the residential sections and binds the company to furnish the city with either 29 additional arc lamps or 50 additional cluster street lamps without additional cost.

Canada

COCHRANE, ALTA.—Negotiations are under way between this town and the Calgary Lt. & Pwr Co. with a view of making a contract under which the company would supply electricity in Cochrane.

KENORA, ONT.—The city of Kenora is planning to install 40 additional lamp standards similar to those already in use. A. E. McLeod is superintendent of municipal electric-light plant.

TORONTO, ONT.—Tenders will be received by T. L. Church, Mayor, chairman of board of control, for furnishing supplies for Department of Works as follows: (1) For construction of Lansdowne Avenue car line, (a) track material, contract "A" (rails, plates, bolts, spikes, etc.); (b) overhead-line material, contract "B" (wire, fittings, etc.); (2) water-tube boilers and mechanical stokers for main pumping station. Specifications and tender form may be obtained upon application at Room 12, purchasing and accounting section of the Department of Public Works, City Hall, Toronto.

Miscellaneous

PEARL HARBOR, HAWAII—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until April 3, for an electric passenger elevator in the naval hospital at the naval station, Pearl Harbor. Plans and specifications may be obtained at above bureau or from the commandant of the station named. H. R. Stanford is chief of bureau.

PANAMA.—Bids will be received at the office of the general purchasing officer of the Panama Canal, Washington, D. C., until March 22, for furnishing conduit boxes, sheet copper, yellow metal, copper tubing, etc. Blanks and general information relating to this circular (No. 904) may be obtained at the above office or the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal. Major F. C. Boggs is general purchasing officer.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MARCH 2, 1915.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York, N. Y.]

1,129,840. TELEPHONE; H. A. Bates, Galesburg, Ill. App. filed Aug. 14, 1914. False calls through accidental movements of receiver hook eliminated.

1,129,842. ELECTRIC FURNACE; J. Blatchford, Oak Park, Ill. App. filed Aug. 19, 1914. Adjustable heat-muffle furnace for laboratory use.

1,129,861. ELECTRIC HEATER FOR LIQUIDS; M. H. Gonzales, Birmingham, Ala. App. filed April 11, 1914. Heating elements spread over top surface of liquid.

1,129,862. PROCESS OF REDUCING ORES; A. E. Greene, Chicago, Ill. App. filed July 15, 1912. Direct production of refined iron, steel or ferro-alloys.

1,129,871. ELECTRIC POCKET LAMP; W. Jerger, Sr., Villengen, and M. Weiss, Berlin, Germany. App. filed May 31, 1913. Pistol type, provided with igniting device or other device of common use.

1,129,878. REGULATING DEVICE FOR MOTOR-DRIVEN COMPRESSORS; F. L. Lucker, Brooklyn, and A. O. Carpenter, Corning, N. Y. App. filed March 11, 1913. Resistance cut out gradually in starting the motor.

1,129,900. SEALING-WAX MELTER; G. S. Proctor and J. B. Prendergast, Ottawa, Ontario, Canada. App. filed May 24, 1913. Electrically heated holder receives stick of sealing wax.

1,129,912. TROLLEY RETRIEVER; I. W. Smith, Dayton, Ohio. App. filed Feb. 3, 1905. Improved controlling means for the rewinding spring.

1,129,942. GASEOUS REPEATER IN CIRCUITS OF LOW IMPEDANCE; H. De F. Arnold, East Orange, N. J. App. filed May 28, 1914. Thermionic repeaters in tandem.

1,129,943. GASEOUS REPEATER IN CIRCUITS OF LOW IMPEDANCE; H. De F. Arnold, East Orange, N. J. App. filed May 28, 1914. Thermionic repeater working into plurality of thermionic repeaters in multiple.

1,129,951. TELEPHONE-EXCHANGE SYSTEM; E. S. Browning, Keefeton, Okla. App. filed July 18, 1913. Eliminates corded plugs and spring jacks, and operator cannot "listen in."

1,129,959. SYSTEM FOR AMPLIFYING ELECTRIC WAVES; E. H. Colpitts, East Orange, N. J. App. filed April 6, 1914. Signaling over ocean cables.

1,129,973. OUTLET-BOX BUSHING; G. A. Gauthier, Hartford, Conn. App. filed Feb. 12, 1914. Clamped to end of flexible conduit or armored cable.

1,129,987. STREET-CAR INDICATOR; T. E. Kearney and A. J. McFarlane, Berkeley, Cal. App. filed May 5, 1913. Operated by co-operating devices on trolley wire and pole.

1,130,008. AUDION; A. McL. Nicolson, Tarrytown, N. Y. App. filed June 6, 1914. Provided with an input electrode having a large surface.

1,130,009. AUDION; A. McL. Nicolson, Tarrytown, N. Y. App. filed June 6, 1914. Has input electrode in the form of a shell.

1,130,017. CENTRIFUGAL CIRCUIT-CHANGING DEVICE FOR ELECTRIC MOTORS; E. S. Pillsbury, St. Louis, Mo. App. filed Jan. 19, 1912. Has no pivotal joints.

1,130,029. TELEPHONE APPARATUS; H. E. Shreeve, Millburn, N. J. App. filed Jan. 14, 1913. Transmitter with substantially horizontal diaphraghm.

1,130,036. DEVICE FOR LOCATING FAULTS IN LINE CONDUCTOR INSULATION; S. D. Sprong, Brooklyn, N. Y. App. filed March 28, 1914. Avoids the difficulties of Wheatstone-bridge principle.

1,130,042. HIGH-CURRENT OUTPUT AUDION; H. J. van der Bijl, New York, N. Y., and A. McL. Nicolson, Tarrytown, N. Y. App. filed June 6, 1914. Efficient arrangement of input electrode, filament and output electrode.

1,130,043. ALTERNATING-CURRENT-RESPONSIVE APPARATUS; H. J. van der Bijl, New York, N. Y. App. filed July 6, 1914. Second pair of electrodes in the region of the stream of ions.

1,130,052. HEATER FOR INCUBATORS; G. F. Armstrong, Hamilton, Ontario, Canada. App. filed Feb. 27, 1914. Sheets of mica wound with wire and arranged on base in form of hollow square.

1,130,079. FIRE-PROTECTION DEVICE FOR CINEMATOGRAPH MACHINES; E. W. Fox, Vancouver, British Columbia, Canada. App. filed Dec. 5, 1913. Automatically closes the beam and viewing apertures of operator's room in case of film catching fire.

1,130,091. PROGRAM-CLOCK APPARATUS; F. F. Landis, Waynesboro, Pa. App. filed Sept. 12, 1906. Does away with use of springs.

1,130,092. ELECTRIC CLOCK; F. F. Landis, Waynesboro, Pa. App. filed Jan. 27, 1906. Secondary-clock construction.

1,130,161. MEANS FOR CONTROLLING ELECTRICALLY OPERATED MECHANISMS AND THE LIKE; H. H. R. Green, Forest Hill, England. App. filed Sept. 27, 1913. Embodies a three-position control switch.

1,130,162. BATTERY CONNECTOR; N. Hale, Corpus Christi, Tex. App. filed Dec. 27, 1913. Improved spring-clip construction.

1,130,172. EMBROIDERY-PATTERN MACHINE; C. Keller, Weehawken, N. J. App. filed April 22, 1912. For double-action embroidery machine jacquards.

1,130,190. TELEPHONE-EXCHANGE APPARATUS; C. H. North, Cleveland, Ohio. App. filed April 4, 1911. "Clement automanual" system.

1,130,191. MORTUARY ILLUMINATING APPARATUS; J. O'Brien, Chicago, Ill. App. filed Sept. 25, 1914. For illuminating casket.

1,130,204. ELECTRIC SWITCH; H. R. Schultz and F. B. Holt, Manchester, Eng. App. filed Oct. 31, 1910. Overload coil and ammeter mechanically supported upon the high-tension conductor to which they are connected.

1,130,206. MAGNETO-ELECTRIC MACHINE FOR COMBINED IGNITION AND ILLUMINATION PURPOSES; F. R. Simms, London, Eng. App. filed July 14, 1913. Two armatures, one for ignition and the other for lighting, rotating between two pairs of pole pieces.

1,130,211. DYNAMO-ELECTRIC MACHINE; C. W. Starker, Pittsburgh, Pa. App. filed Feb. 1, 1912. Punched sheet-metal end bracket supporting the bearing.

1,130,218. SOLDERING IRON; S. Trood, Wilkinsburg, Pa. App. filed July 29, 1913. Readily renewable heater and removable working tip.

1,130,224. AIR-BRAKE SYSTEM; J. E. Wallace, New York, N. Y. App. filed Dec. 1, 1904. "Straight-air" system with electric control.

1,130,257. GENERATOR FOR INTERMITTENT ELECTRIC CURRENTS; J. Carter, Waukegan, Ill. App. filed March 9, 1914. Armature reciprocates between one pole of permanent magnet and the two members of a duplex core attached to other pole of magnet.

1,130,260. TRANSFORMER; W. M. Dann, Wilkinsburg, Pa. App. filed Aug. 7, 1911. Series type for supplying energy to the tripping coils of circuit-breakers.

1,130,264. RESILIENT DRIVING CONNECTION; G. M. Eaton, Wilkinsburg, Pa. App. filed May 27, 1912. Between motor and driving wheels of electric locomotive.

1,130,265. RECTIFIER SYSTEM; C. Le G. Fortescue, Pittsburgh, Pa. App. filed June 21, 1912. Limits current to harmless value upon occurrence of short-circuit.

1,130,268. ELECTRICAL TRANSFORMER; E. Heafely, Basel, Switzerland. App. filed Jan. 10, 1912. Insulating sleeve for oil transformers of the core type.

1,130,269. ELECTRICAL TRANSFORMER; F. Heafely, Basel, Switzerland. App. filed Jan. 10, 1912. Insulating sleeve of polygonal cross-section.

1,130,320. CIRCUIT CONTROLLER; W. Morrison, Des Moines, Ia. App. filed Jan. 15, 1913. Circuit-closing element rotated step by step in same direction by reciprocating actuating bar.

1,130,340. TROLLEY SWITCH; J. J. Ruddick, Newton, Mass. App. filed March 10, 1913. Trip engaged by trolley wheel swings transversely to the trolley wire.

1,130,353. SYSTEM OF AUTOMATIC BLOCK SIGNALING; F. Townsend, New York, N. Y. App. filed June 16, 1904. Insulated rail sections with special bonds.

1,130,361. TROLLEY HEAD; A. L. Williams, Los Angeles, Cal. App. filed May 15, 1914. Has a plurality of self-adjusting trolley wheels.

1,130,391. HEADLIGHT; C. J. Geterman, Canton, Ohio. App. filed March 21, 1908. Special mounting of electrodes.

1,130,392. ELECTRICAL OVEN AND KILN; L. H. Giddings, Pasadena, Cal. App. filed June 29, 1911. Baker's oven, or for like purposes.

1,130,451. PROJECTING LANTERN; E. Unger, New York, N. Y. App. filed March 6, 1913. Arc lamp of cheap construction.

1,130,452. RECORDER FOR FREIGHT CARS; J. R. Vedder, Reading, Ohio. App. filed Sept. 18, 1911. Identifying marks of freight cars passing a given point are automatically registered.

1,130,460. ELECTRIC ARC LAMP; A. Zanotta, Milan, Italy. App. filed Oct. 31, 1914. Plurality of arcs disposed in series to absorb the tension on the line.

1,130,476. RHEOSTAT CONTROLLER; G. P. Carroll, Bridgeport, Conn. App. filed April 12, 1907. Thermostatic control useful in refrigerating systems.

1,130,482. JUNCTION BOX; C. W. Davis, Edgeworth, Pa. App. filed March 24, 1909. Partition divides it into two chambers.

1,130,483. TERMINAL FOR CABLES ENTERING JUNCTION BOXES; C. W. Davis, Edgeworth, Pa. App. filed March 19, 1913. Connects terminal to junction-box wall without the usual need for machining the walls.

1,130,484. ELECTRIC FUSE; C. W. Davis, Edgeworth, Ia. App. filed April 22, 1913. Magnet in circuit with fuse strips widens the gap upon rupture.

1,130,485. ELECTRIC FUSE; C. W. Davis, Edgeworth, Pa. App. filed May 3, 1913. Magnet shifts fuse casing to break circuit thereto upon blowing of fuse.

1,130,486. ELECTRIC FUSE; C. W. Davis, Edgeworth, Pa. App. filed May 19, 1913. High-tension; explosive forces of the fusible element have no prejudicial effect upon the fuse structure.

1,130,487. ELECTRIC FUSE; C. W. Davis, Edgeworth, Ia. App. filed June 18, 1913. Oil-fuse construction with means for consuming energy released upon blowing of fuse.

1,130,522. PARTY-LINE LISTENING-IN-DETECTING DEVICE; C. A. Kramer, Spokane, Wash. App. filed March 6, 1914. Mechanically operated bell set into operation by lifting of receiver to "listen in."

1,130,547. ELECTRIC MOTOR; F. L. Sessions, Columbus, Ohio. App. filed Aug. 16, 1906. Short-bearing construction for armature.

1,130,567. ELECTRIC LANTERN; B. K. Bunch, Marshall, Mo. App. filed Aug. 5, 1914. Sheet-metal hood and handle support attachable to dry cell.

1,130,608. TELEPHONE ATTACHMENT; P. A. Johnson, Springfield, Ore. App. filed Nov. 12, 1912. For preventing eavesdropping on intercommunicating system.

1,130,612. TROLLEY PROTECTIVE SYSTEM; A. Klimes, Chicago, Ill. App. filed Dec. 20, 1910. Sectional trolley.

1,130,626. BASE MEMBER FOR SEPARABLE ATTACHMENT PLUGS; J. G. Peterson, Jersey City, N. J. App. filed May 7, 1914. Details of construction.

1,130,628. ROTARY IGNITER; B. W. Pierce, Appleton, Wis. App. filed Feb. 18, 1913. Make-and-break.

1,130,633. POLARITY INDICATOR; F. W. Roller, East Orange, N. J. App. filed Dec. 27, 1912. Indicates "charging," "discharging" or "off" conditions of storage battery.

1,130,640. BATTERY SEPARATOR AND PROCESS FOR MAKING THE SAME; J. M. Skinner, Philadelphia, Pa. App. filed May 13, 1914. Of coniferous wood, shaped and boiled in water.

1,130,648. MAGNETO SEPARATOR; G. Ullrich, Magdeburg, Germany. App. filed Nov. 25, 1913. Obtains a sharper division between the several grades or kinds of particles.

1,130,650. PROCESS OF HARDENING THE CUTTING PORTIONS OF CUTTING TOOLS; J. Whitaker, North Wales, Pa. App. filed Aug. 23, 1910. Electrically hardening teeth of hack-saw blade.

1,130,654. RELAY; H. R. Allensworth, Columbus, Ohio. App. filed April 14, 1911. Vibratable diaphragm counterbalanced between two fluids.

1,130,676. ELECTRIC HORN; D. P. Perry, Chicago, Ill. App. filed Nov. 3, 1905. Buzzer flexibly connected with diaphragm.

1,130,686. MEANS FOR EXCITING THE COMMUTATING POLES OF A DYNAMO-ELECTRIC MACHINE; J. L. Woodbridge, Philadelphia, Pa. App. filed June 8, 1912. Rotary converter.

1,130,687. CAR-AXLE LIGHTING SYSTEM; J. L. Woodbridge, Philadelphia, Pa. App. filed Jan. 10, 1908. Includes dynamo with mechanically connected exciter and a source of constant potential connected to one set of brushes of the exciter.

1,130,688. RAPID-PRINTING TELEGRAPH SYSTEM; C. G. Ashley, Chicago, Ill. App. filed April 28, 1910. Perforations spaced to operate transmitting tape at slow speed.